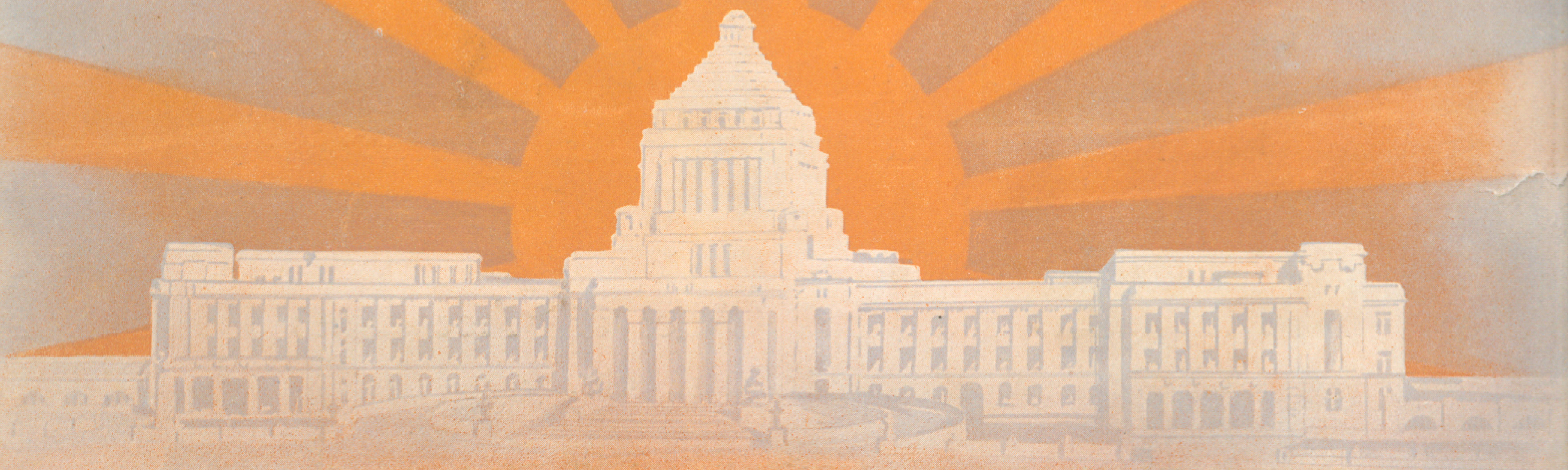
The Far Eastern Review

Reconstruction Number
June-July, 1925



A Monument To The Japanese Engineer

The Reconstruction of

Tokio

and

Yokohama

M. S.

Part 1 of a digital scan of the combined June & June,1925 edition (Volume XXI) of The Far Eastern Review. This part comprises the front cover, 'CONTENTS' & ADVERTISERS lists, Advertising pages *1 - 80* and pages 243-394, advertising pages *81-122* & the magazine's rear cover

Scanned from the 'P. A. Crush Chinese Railway Collection'[1]

Note: The June -July 1925 edition of The Far Eastern Review was a special combined two-month bumper "Reconstruction Number" dedicated to the work of Japanese engineers who had rebuilt devastated industrial plants and infrastructure of "Tokio" (Tokyo) and Yokohama following the 'Great Kanto Earthquake' of 1923.

.

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See pages 16, 17, 18, 19 for Special Advertisements

FOUNDED, 1904

The Far Eastern Review

ENGINEERING + FINANCE + COMMERCE

THE PIONEER IN ITS FIELD

A Monthly Review of Far Eastern Trade, Finance and Engineering, Dedicated to the Industrial Development and Advancement of Trade in Far Eastern Countries.

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NEW YORK: Major Jack Hamilton, Special Representative, 50 Church Street

GREAT BRITAIN: Walter Judd, Ltd., 81-87 Gresham Street, Bank, London, E.C.

MANILA OFFICE: Fleming, Percy Smith and Seth, Roxas Building, Escolta.

BERLIN: Rudolf Mosse, 46-49 Jerusalemer Strasse.

SUBSCRIPTION IN CHINA: $10.00 Mexican, U. S. & Philippines Gold $5.00, Elsewhere $12.00 Mexican per annum

VOL. XXI JUNE-JULY, 1925 NO. 6-7

CONTENTS:

**Illustrated with Maps or Photographs*

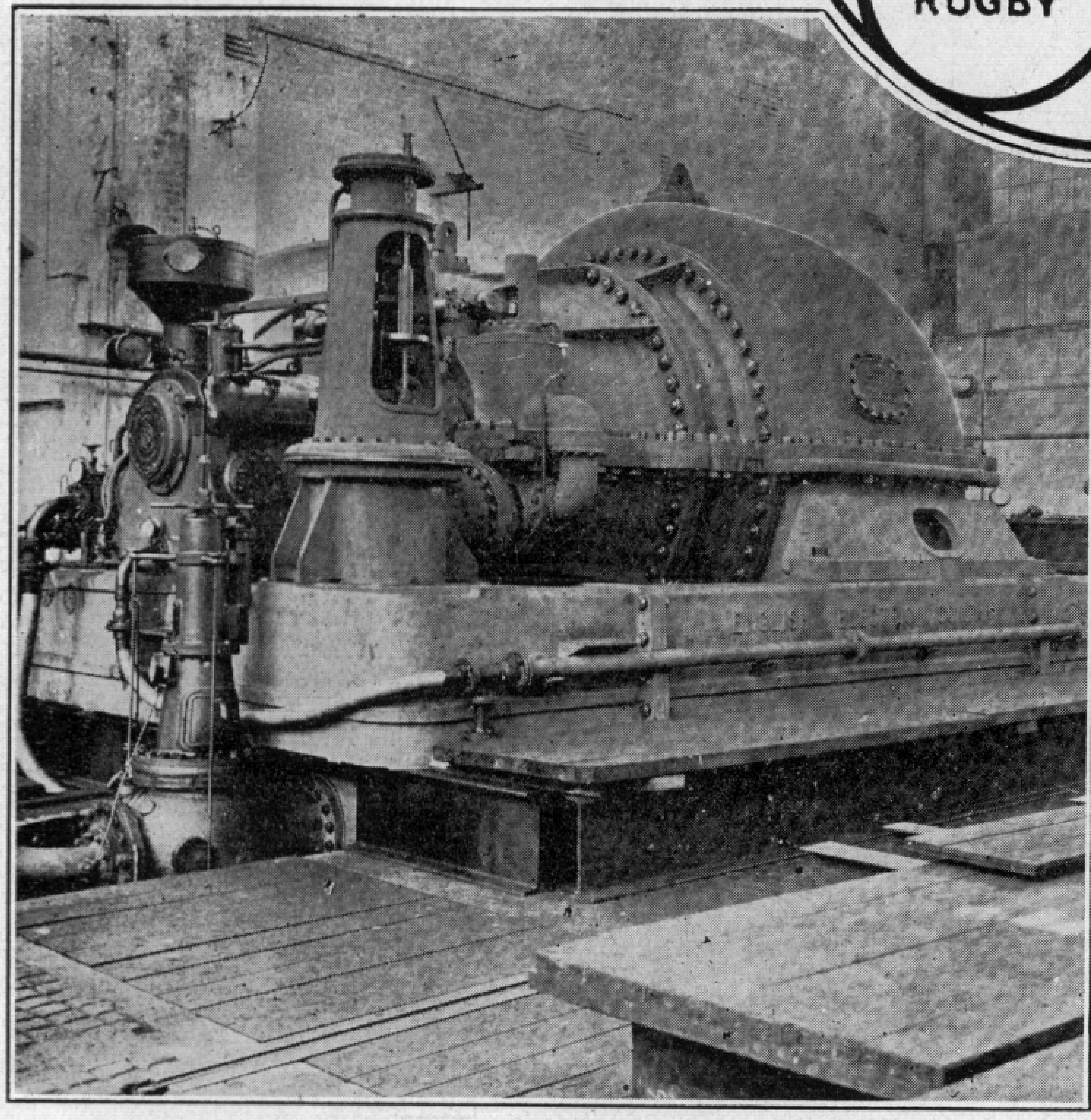
Registered at the Chinese Post Office as a Newspaper.

ALPHABETICAL LIST OF ADVERTISERS

THE
ENGLISH ELECTRIC
COMPANY LIMITED

ORDNANCE COVENTRY
PHOENIX BRADFORD
DICK KERR PRESTON
WILLANS RUGBY
STAFFORD WORKS

WATER TURBINES
STEAM TURBINES
FULLAGAR DIESEL ENGINES



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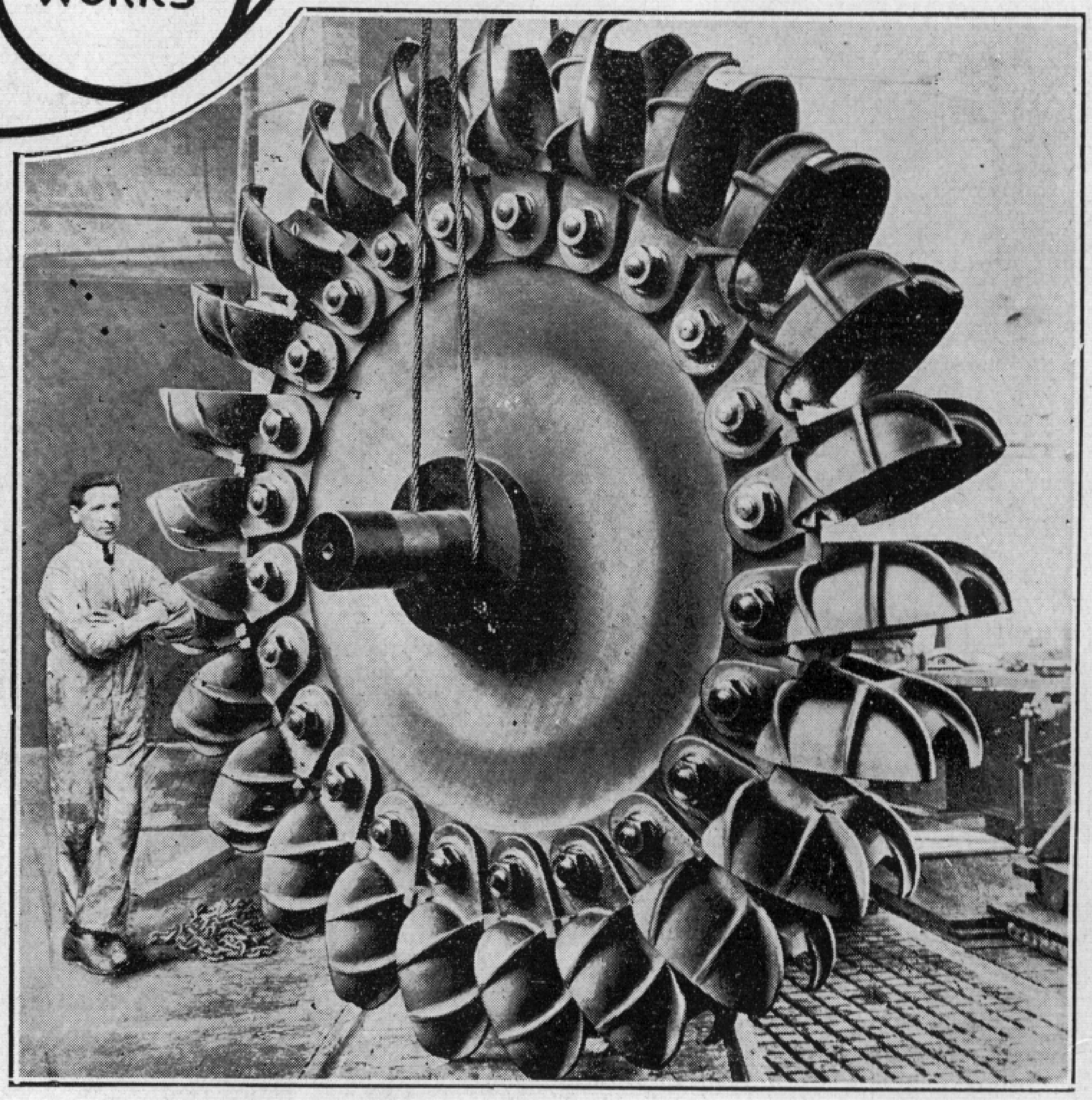

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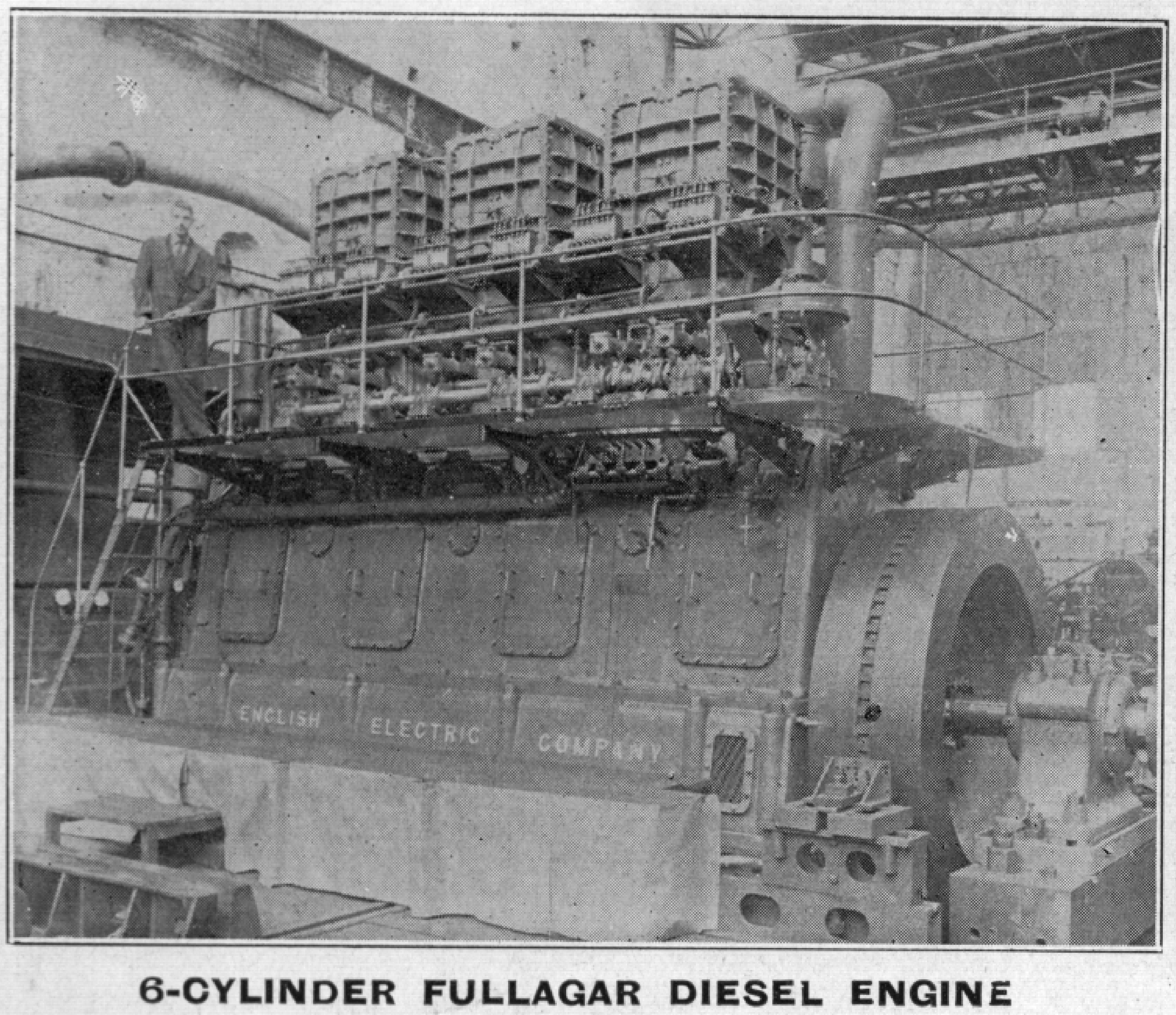
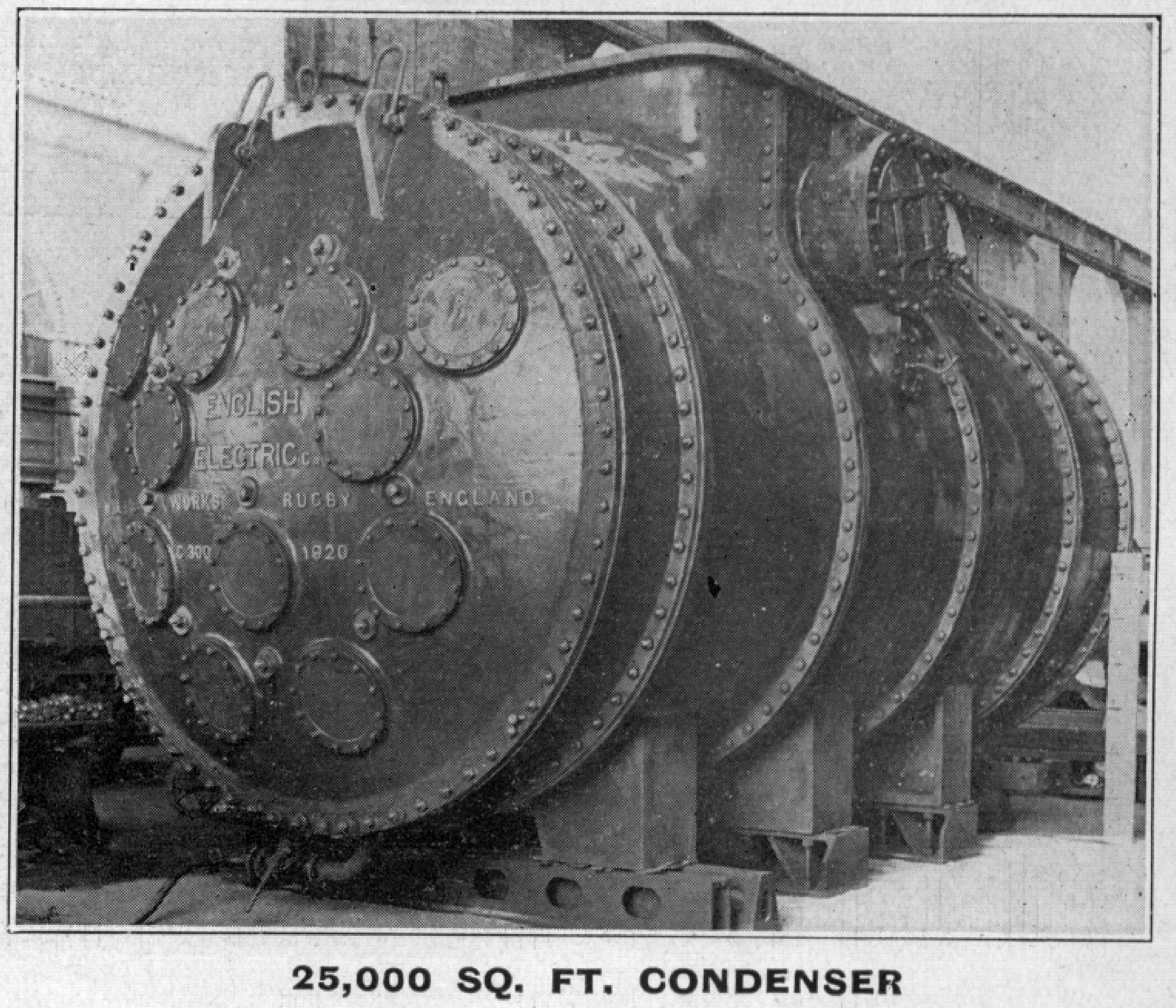


6-CYLINDER FULLAGAR DIESEL ENGINE ON TEST



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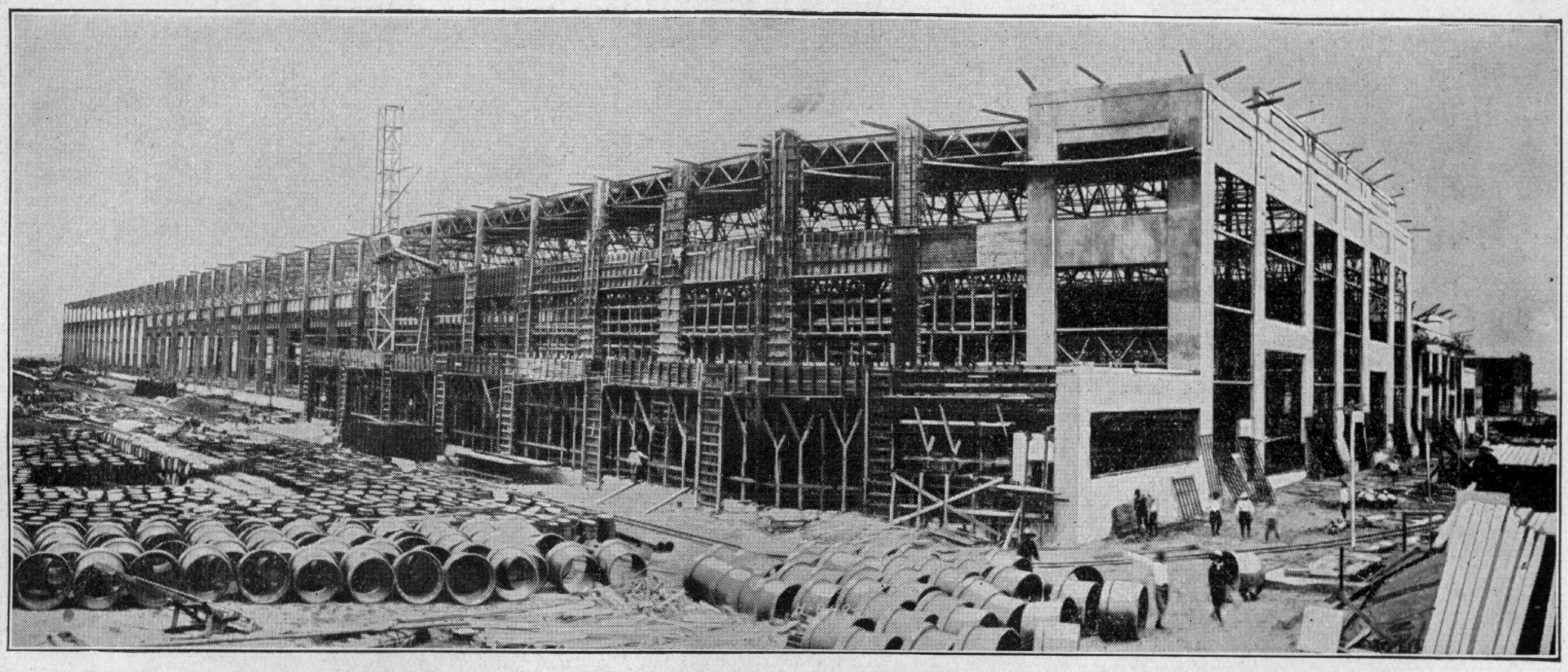
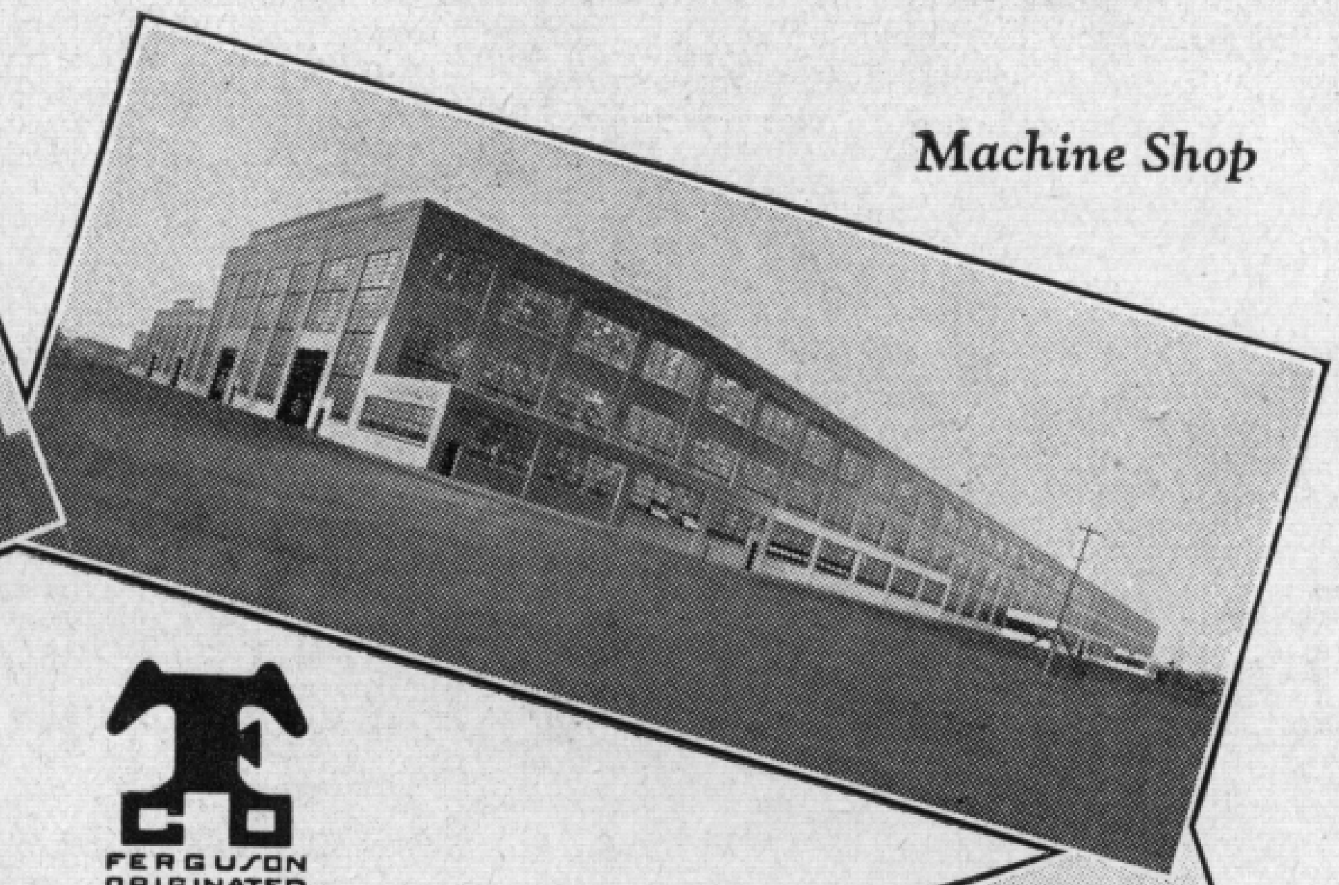


Shibaura Engineering Works, Tokio, Japan. Photo—Steel Work Completed, Concrete Being Poured.

Pattern Shop

Machine Shop



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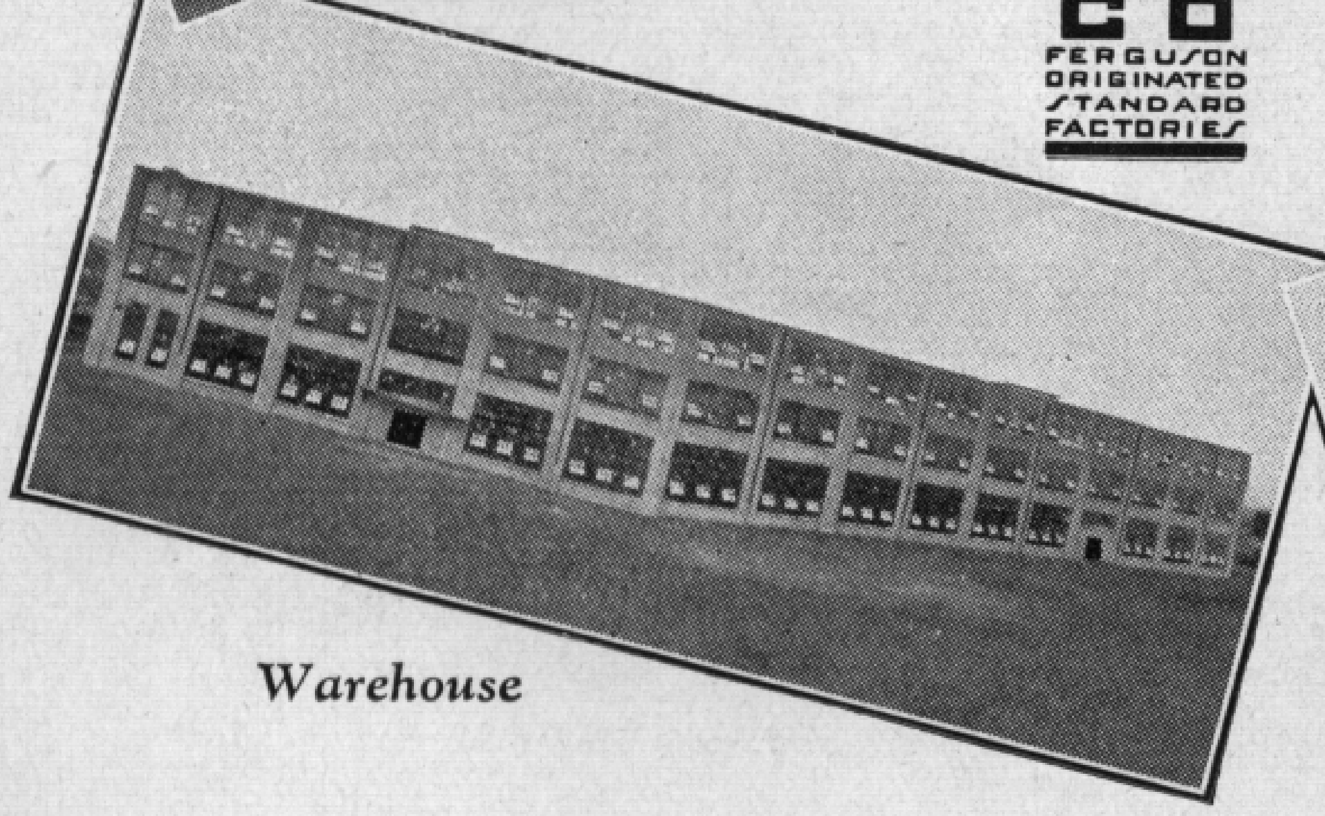
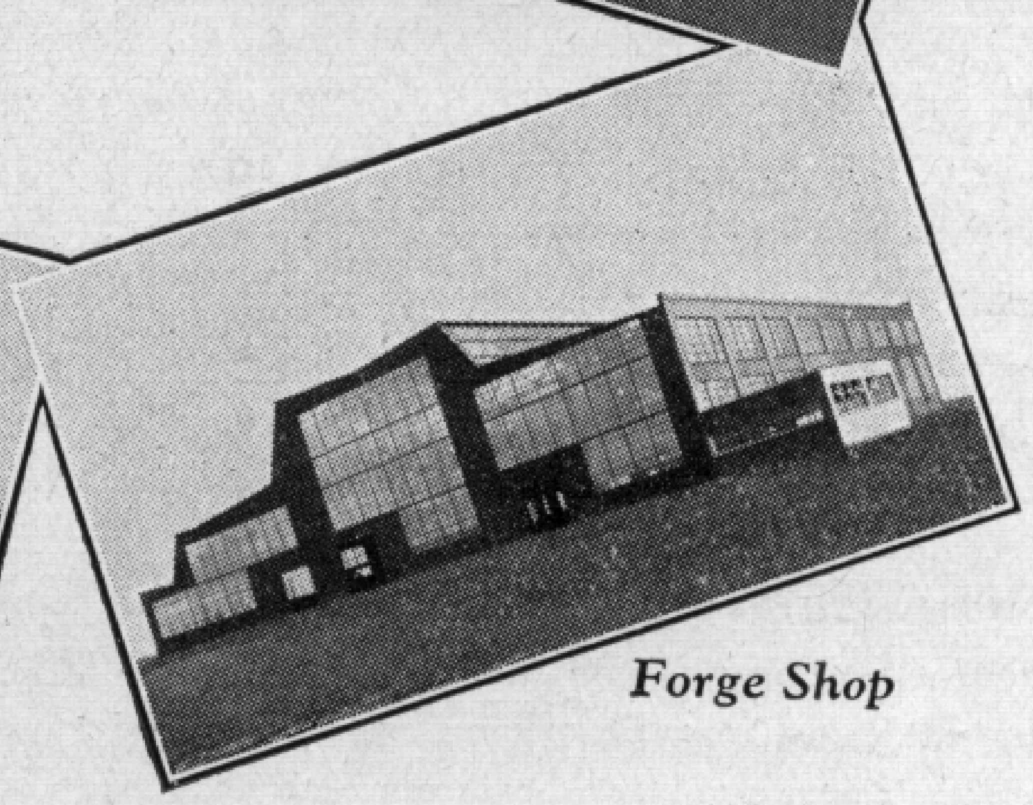


Warehouse



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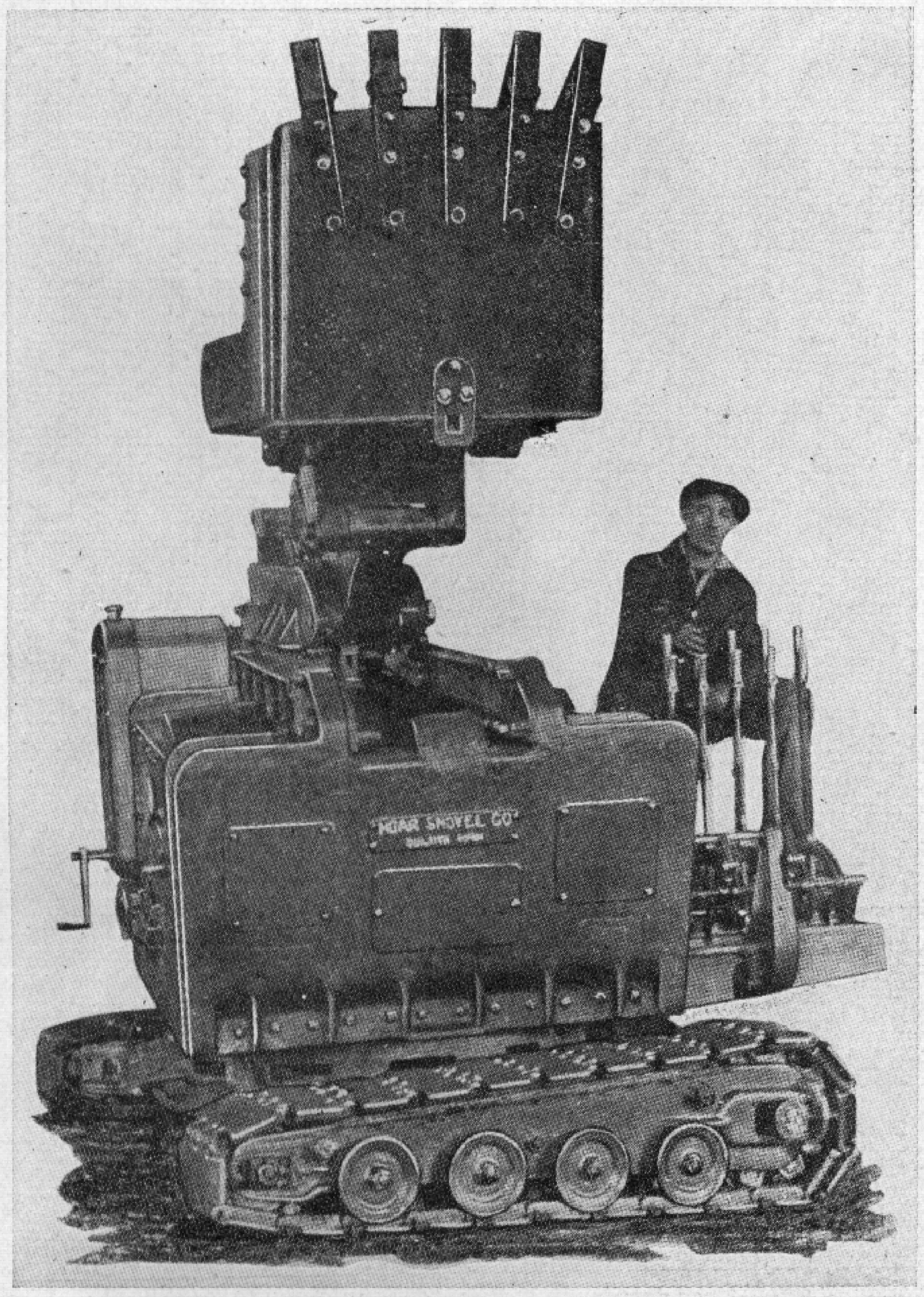

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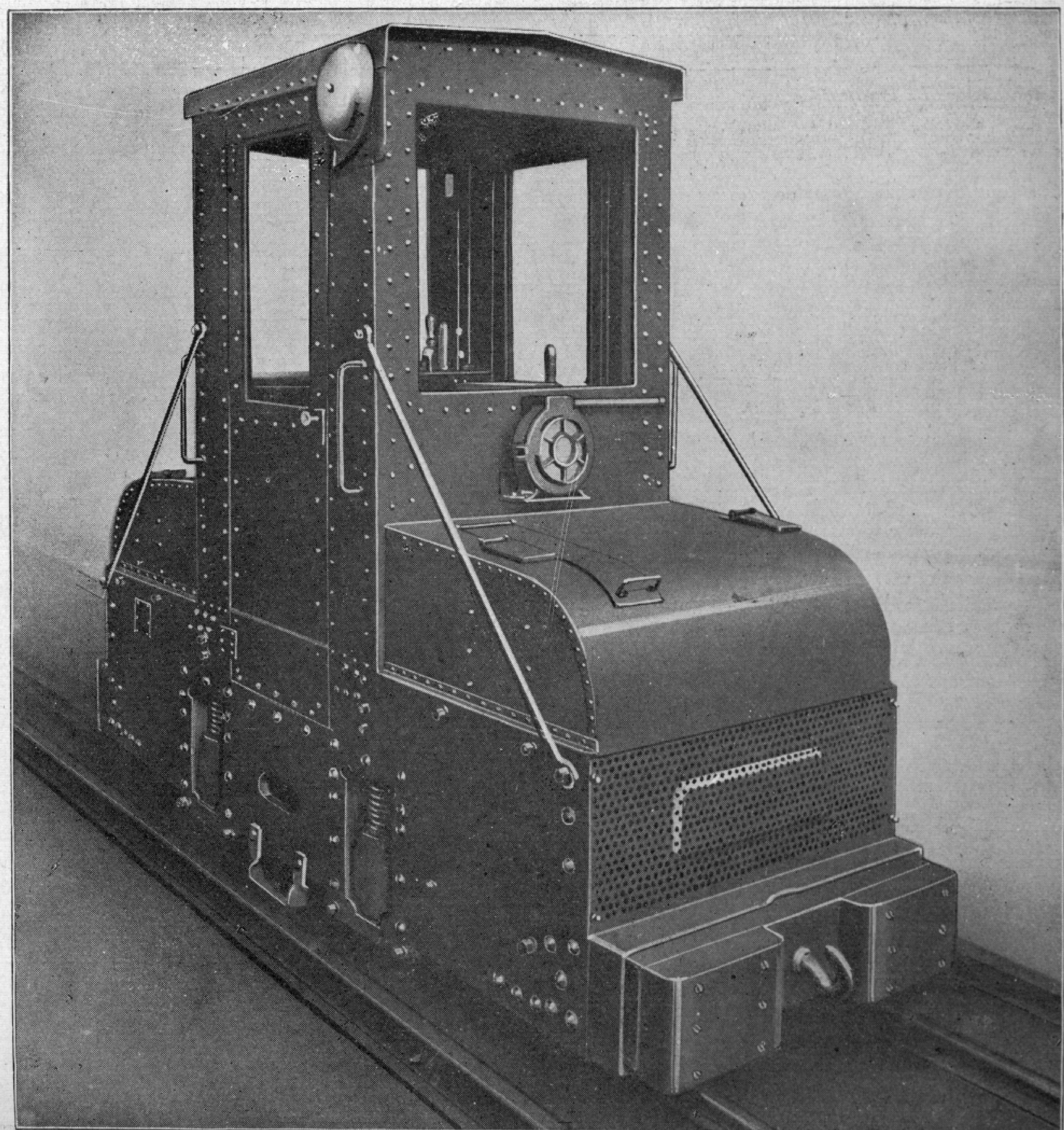
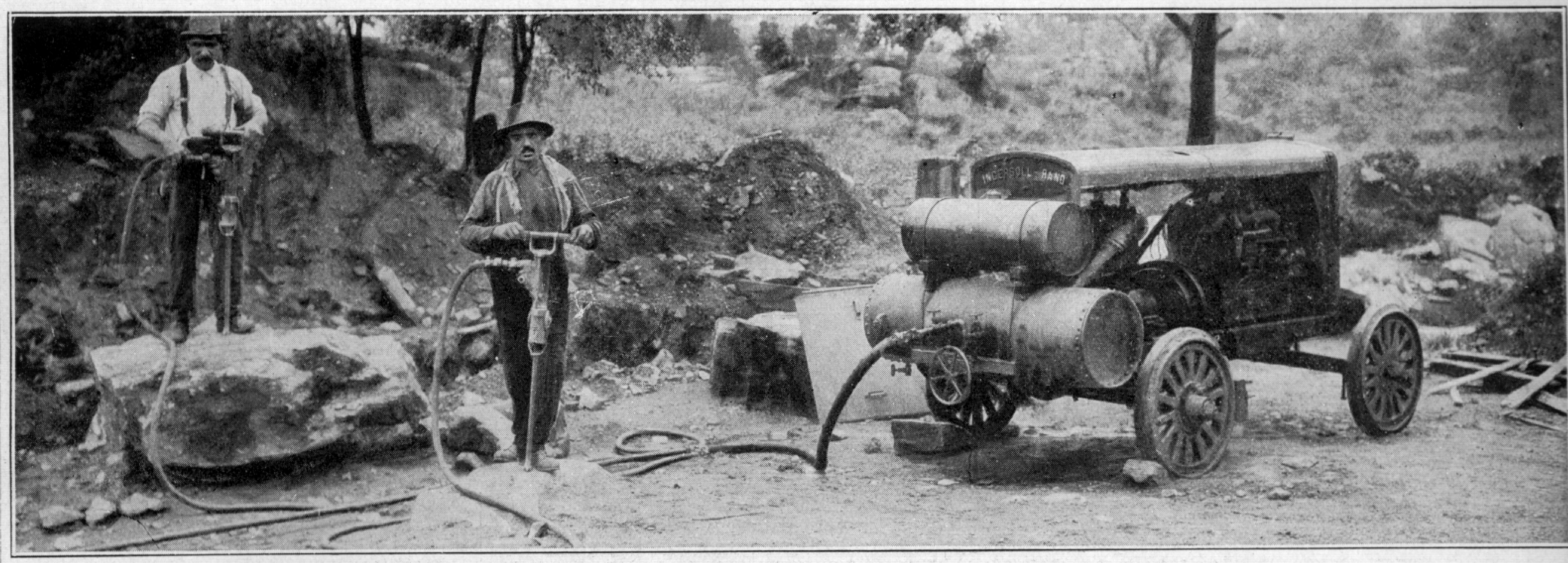


5-Ton Locomotive as supplied to Namazuta Mine. Six Machines supplied



5 by 5, Type 20, Ingersoll Rand Portable Air Compressor driven by Gasoline Engine, operating Jackhammers on Road Building.

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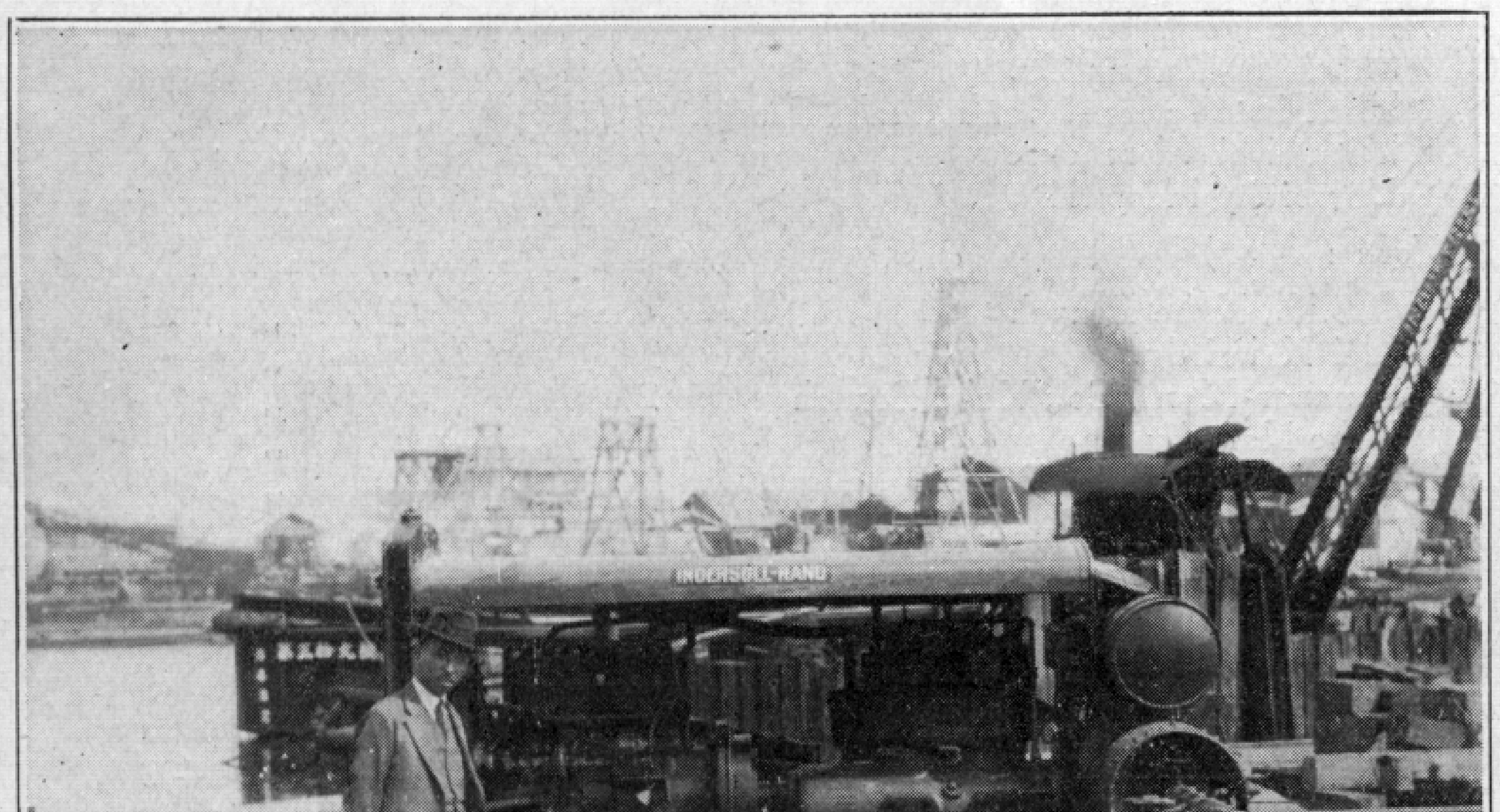
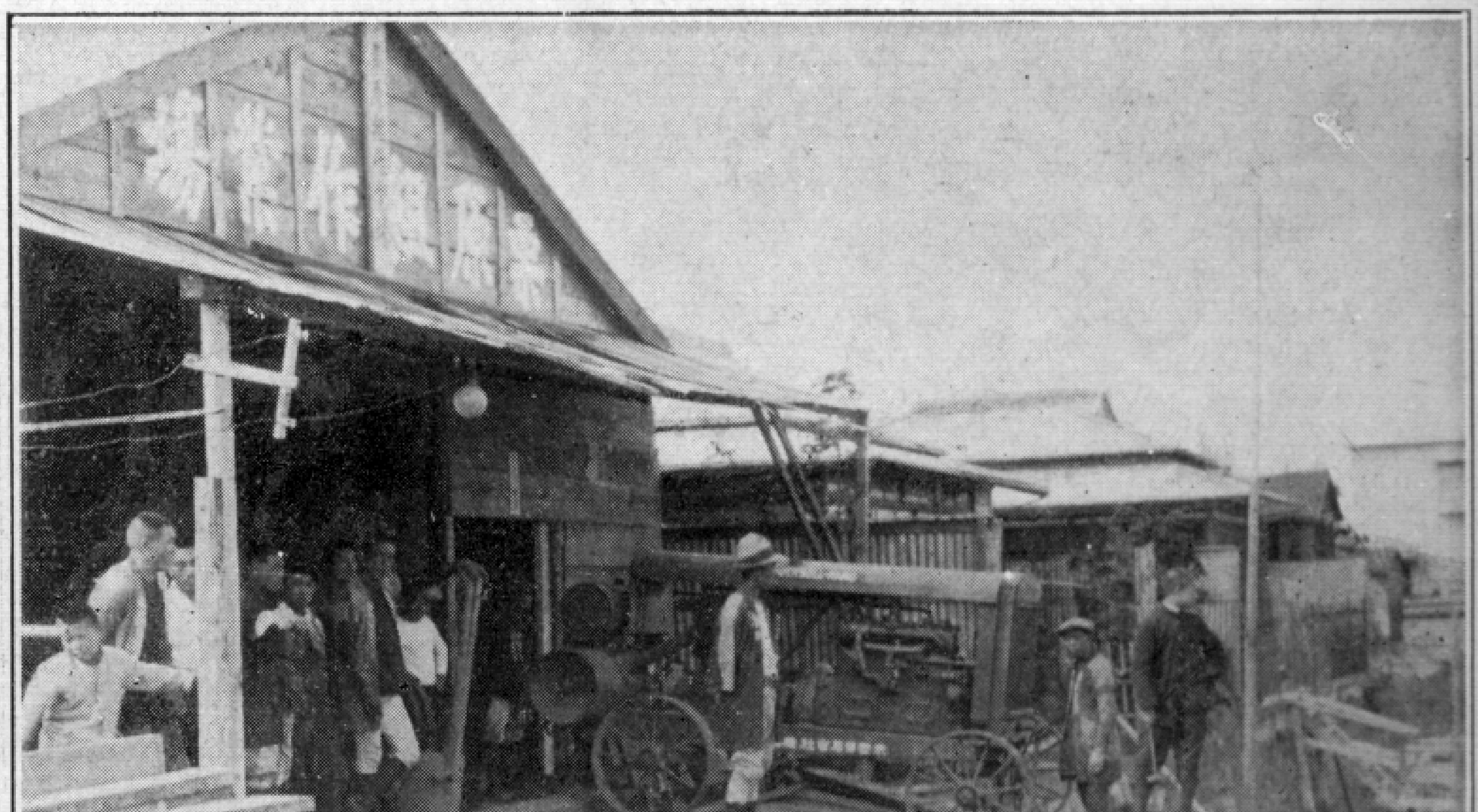
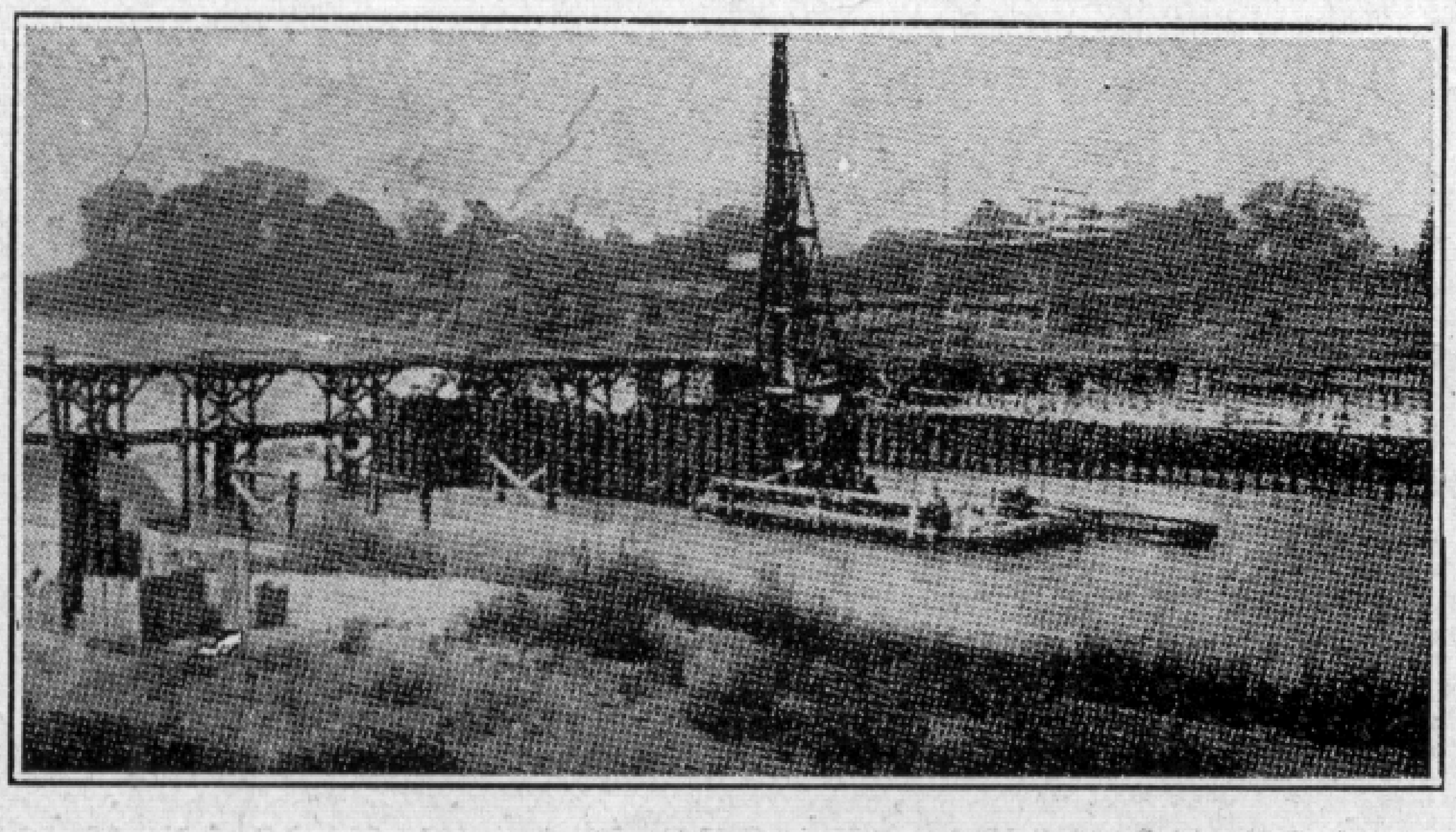


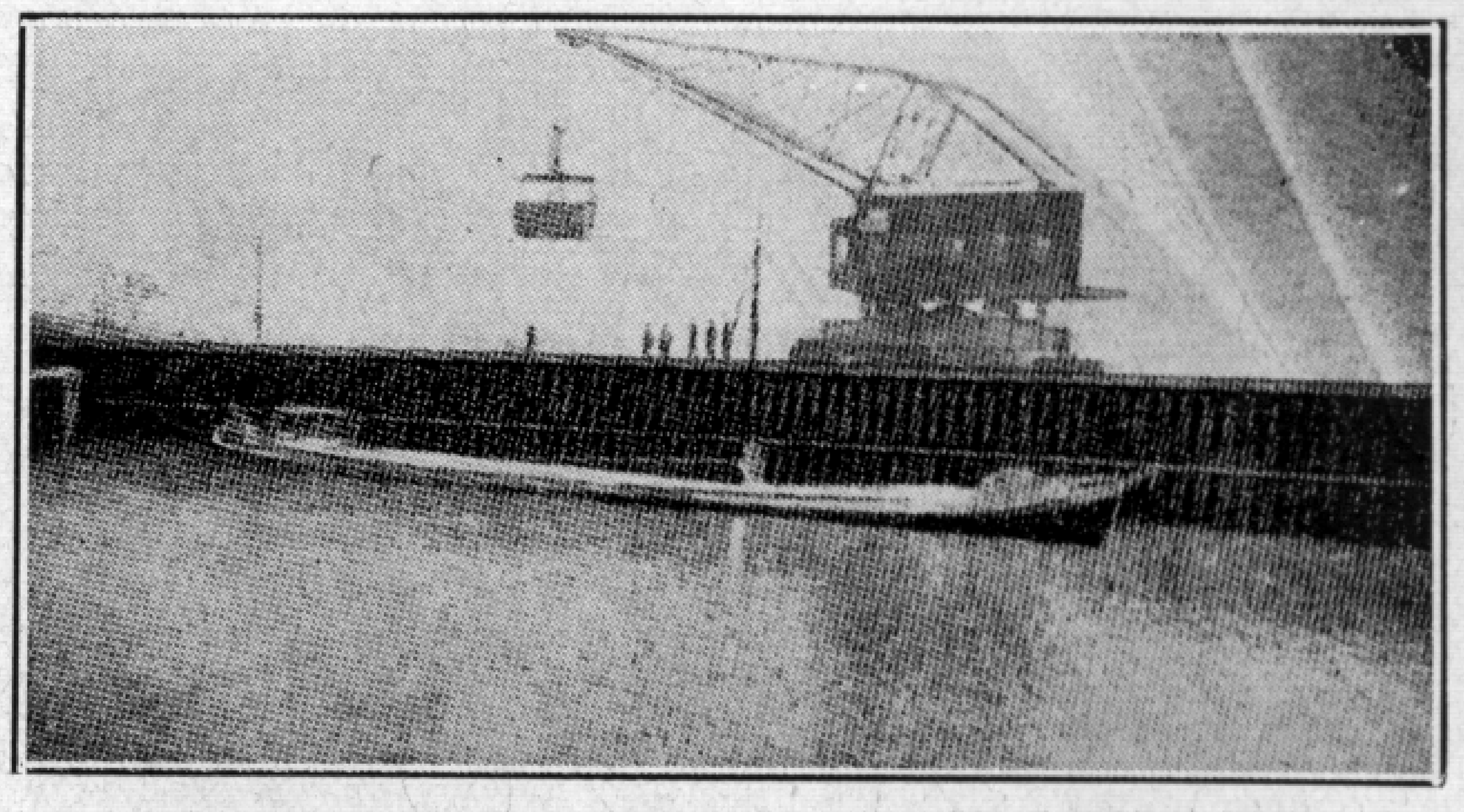
Ingersoll Rand, Size 9-ft. by 8-ft., Type 20, Gasoline Engine Driven Portable Air Compressor Unit, mounted on a boat and employed by the Tokyo Reconstruction Bureau for the Caisson Work of the New Sumida River Bridges.



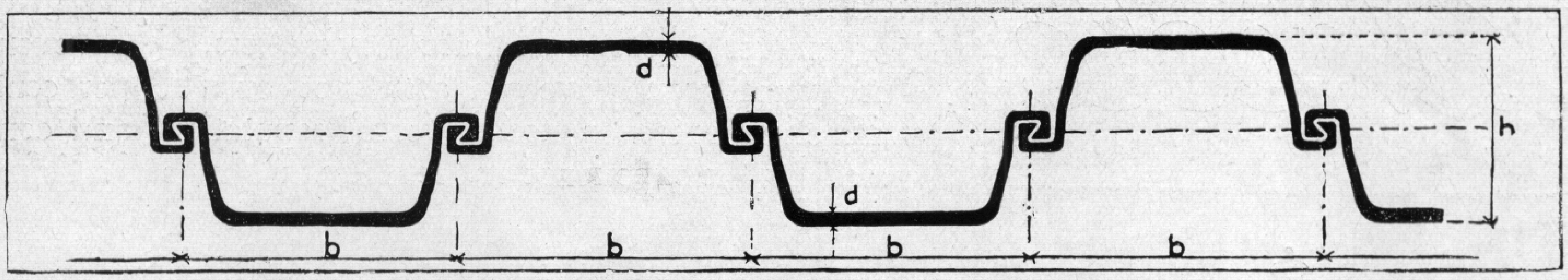
One of Many Ingersoll Rand Portable Air Compressor Units used by the Tokyo Reconstruction Bureau and the Tokyo Municipality in reconstruction work.

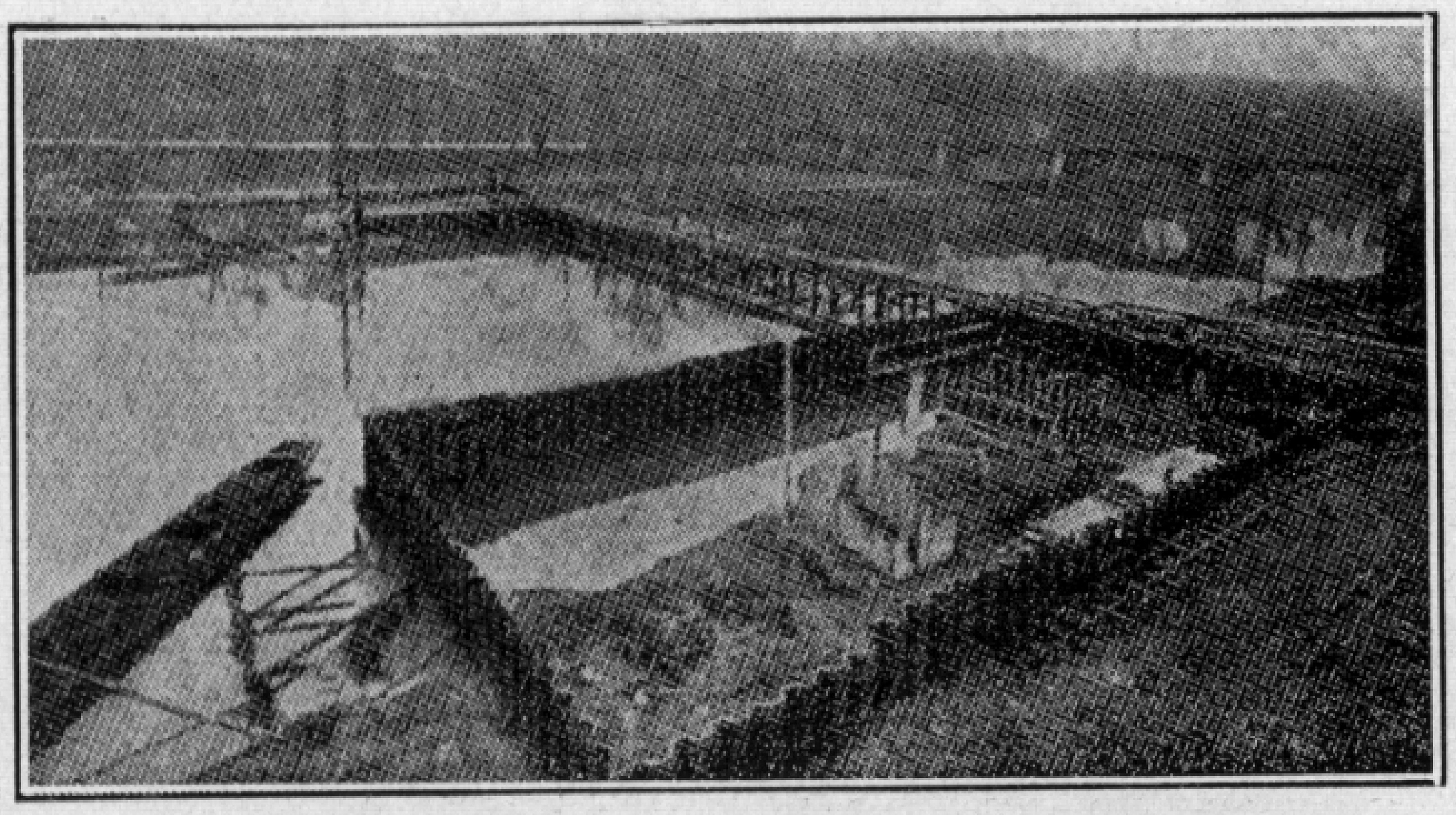


Dam in Oberföhrung for the Power Installation "Mittlere Isar A.-G., Munich"

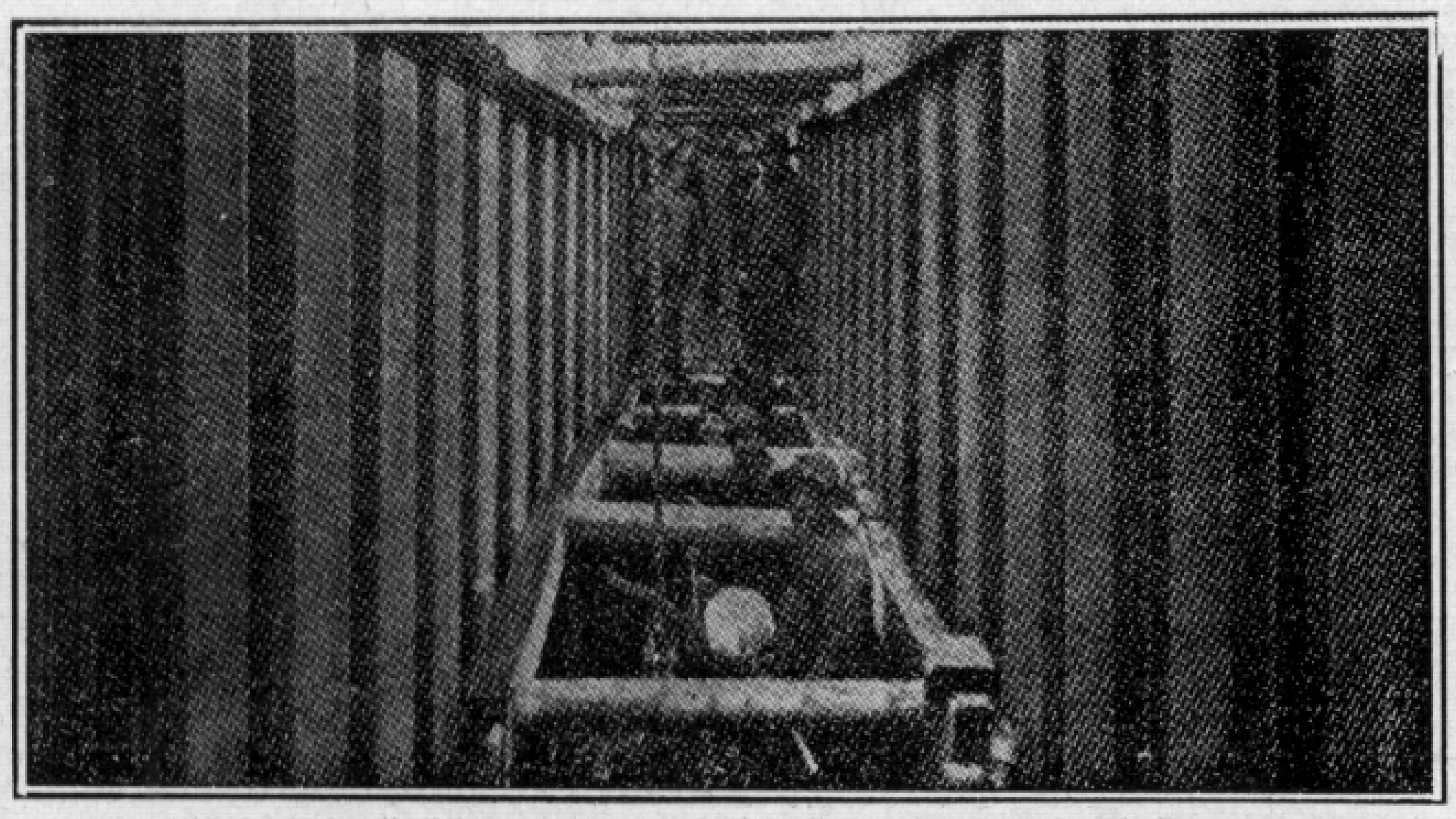


Embankment "Wilhelmine-Viktoria" Colliery Port at Gelsenkirchen belonging to the Hibernia Mining Co.





Cofferdams for the pier foundation of the Neckar Bridge in Cannstatt constructed of Larssen Steel Piling



Trench for sewer construction for the Town of Oberhausen

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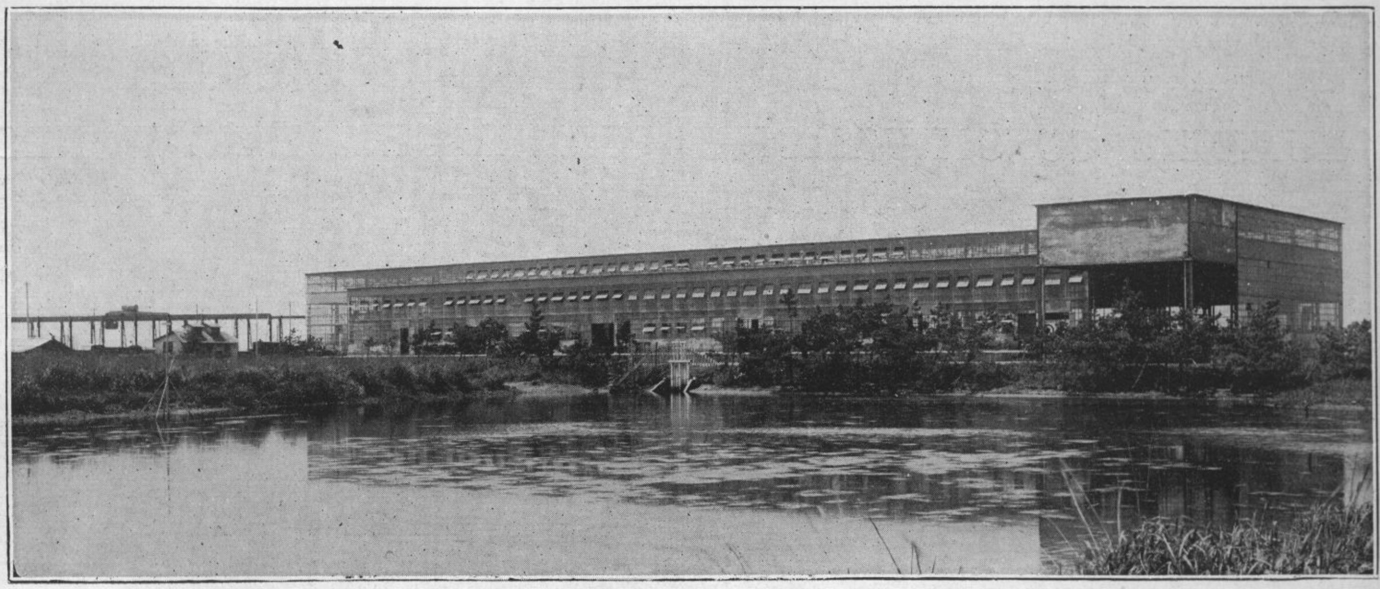

Truscon Company of Japan Factory at Kawasaki: The Sash Factory Building

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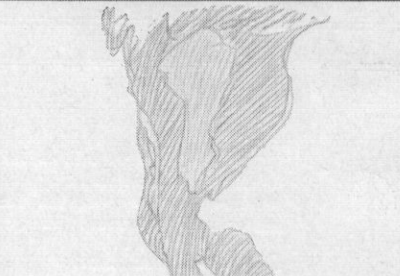

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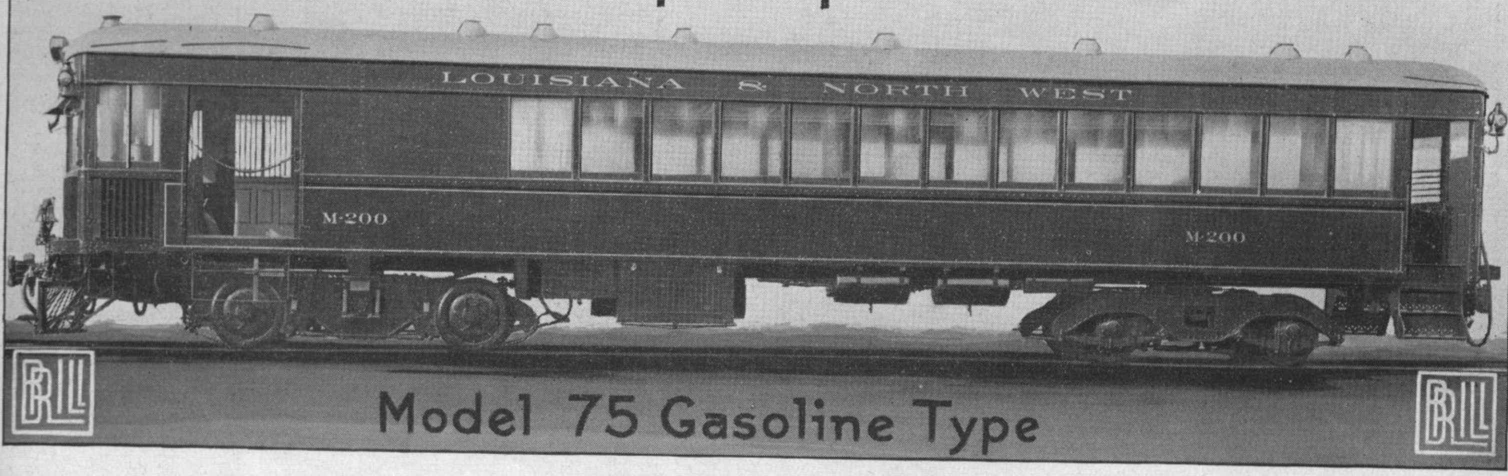

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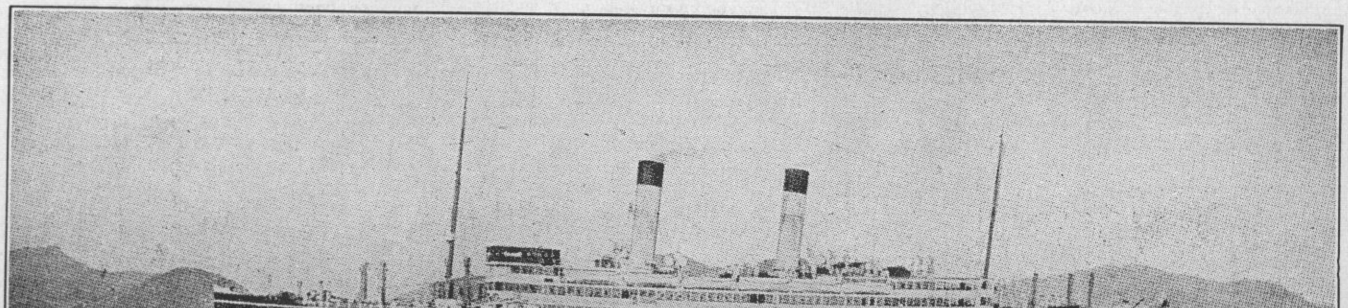

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Extreme Length	523	Ft.
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Extreme Length	371	Ft.
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Width of Entrance on Top	66	,,
,, ,, ,, ,, Bottom	53	,,
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Extreme Length	728.9	Ft.
Length on Blocks	714	,,
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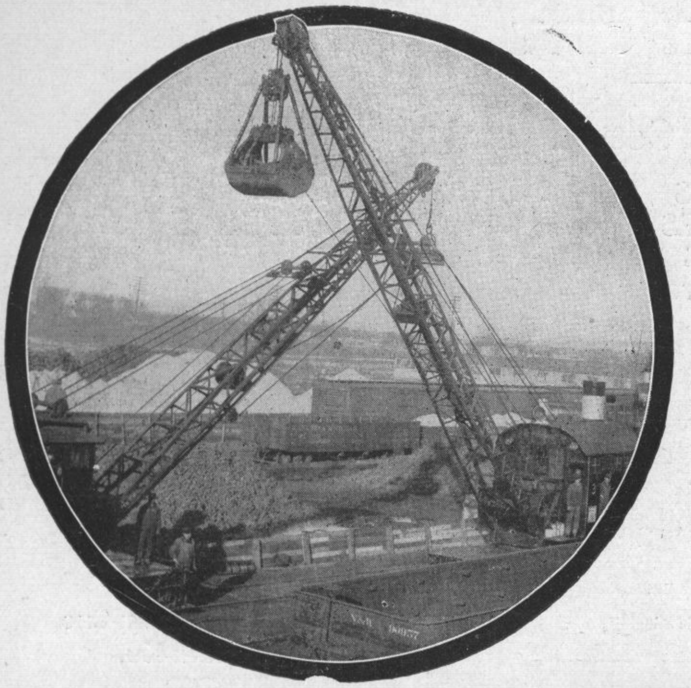

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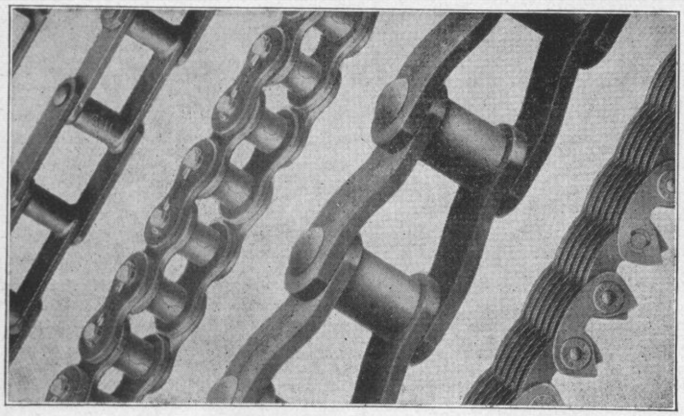

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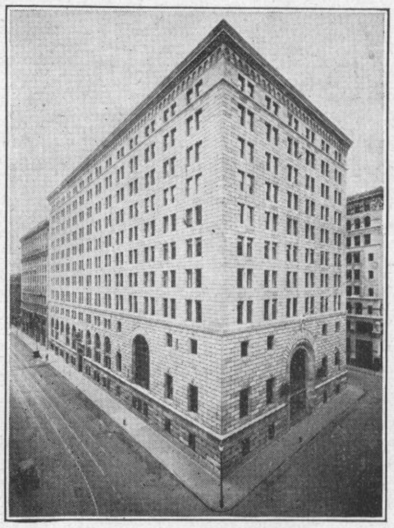

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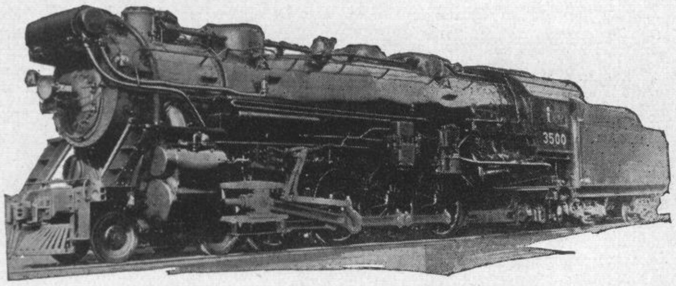

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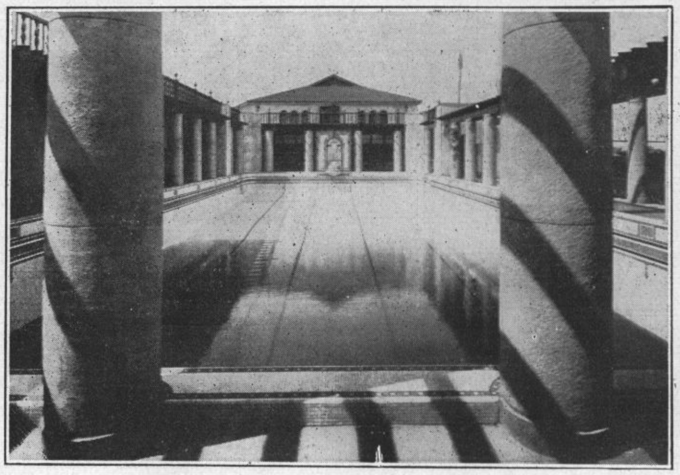

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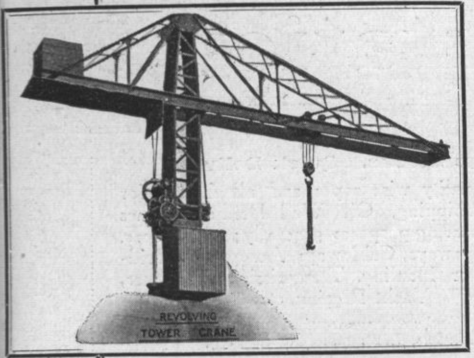

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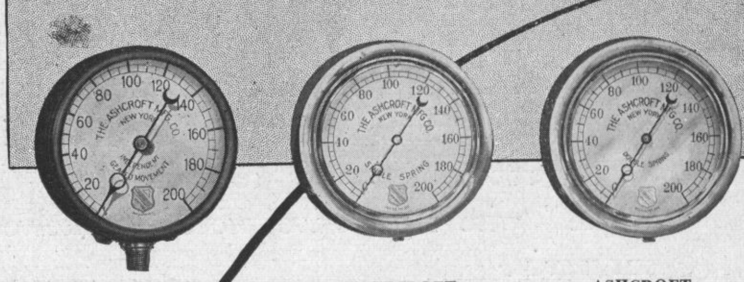

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Single Spring Gauge
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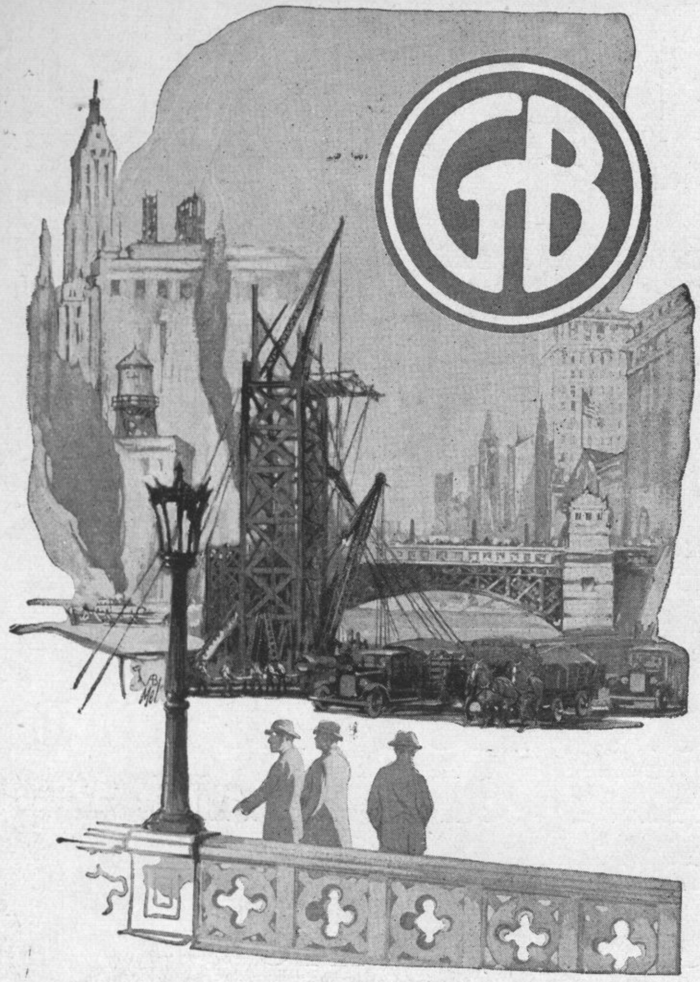

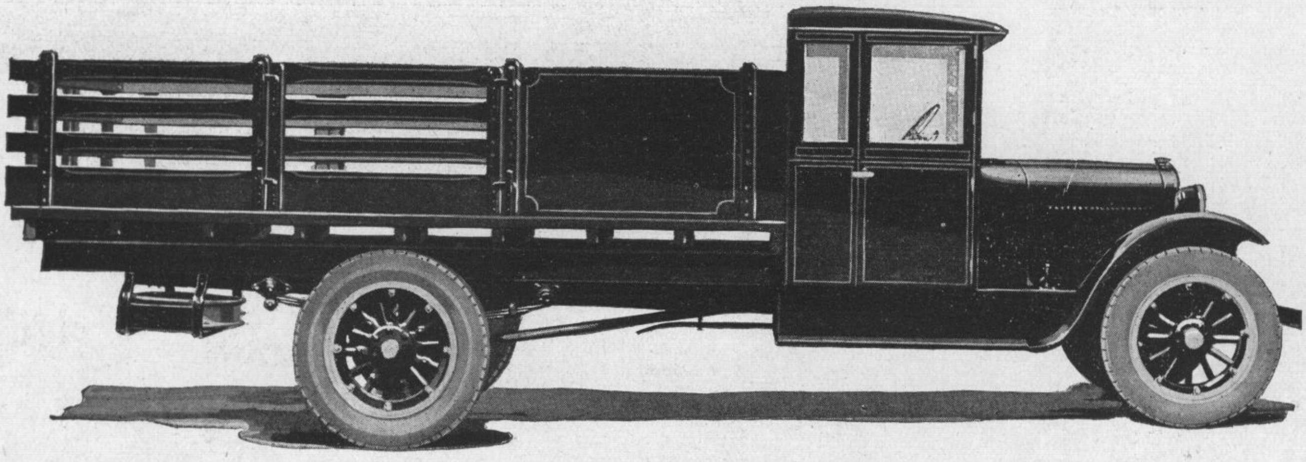

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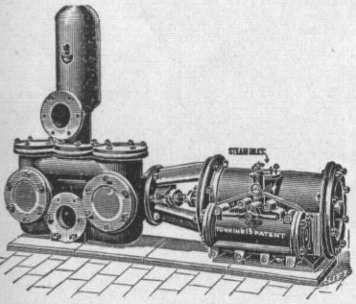

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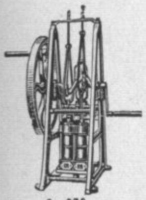


Fig. 228.

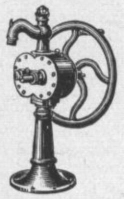
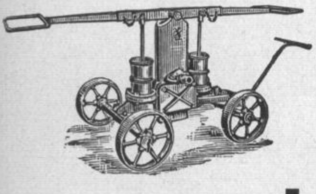
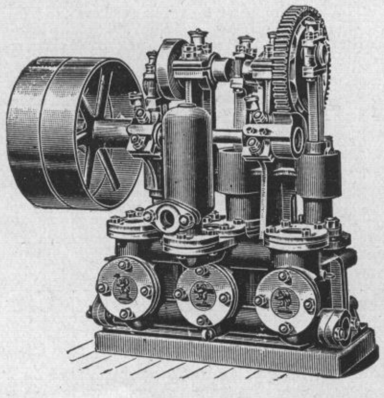


Fig. 160.





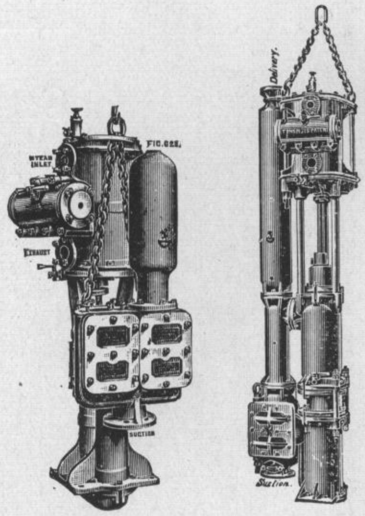


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Fig. 191.

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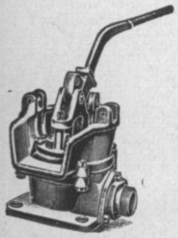

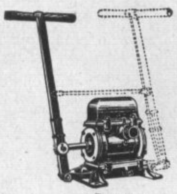

Fig. 185.

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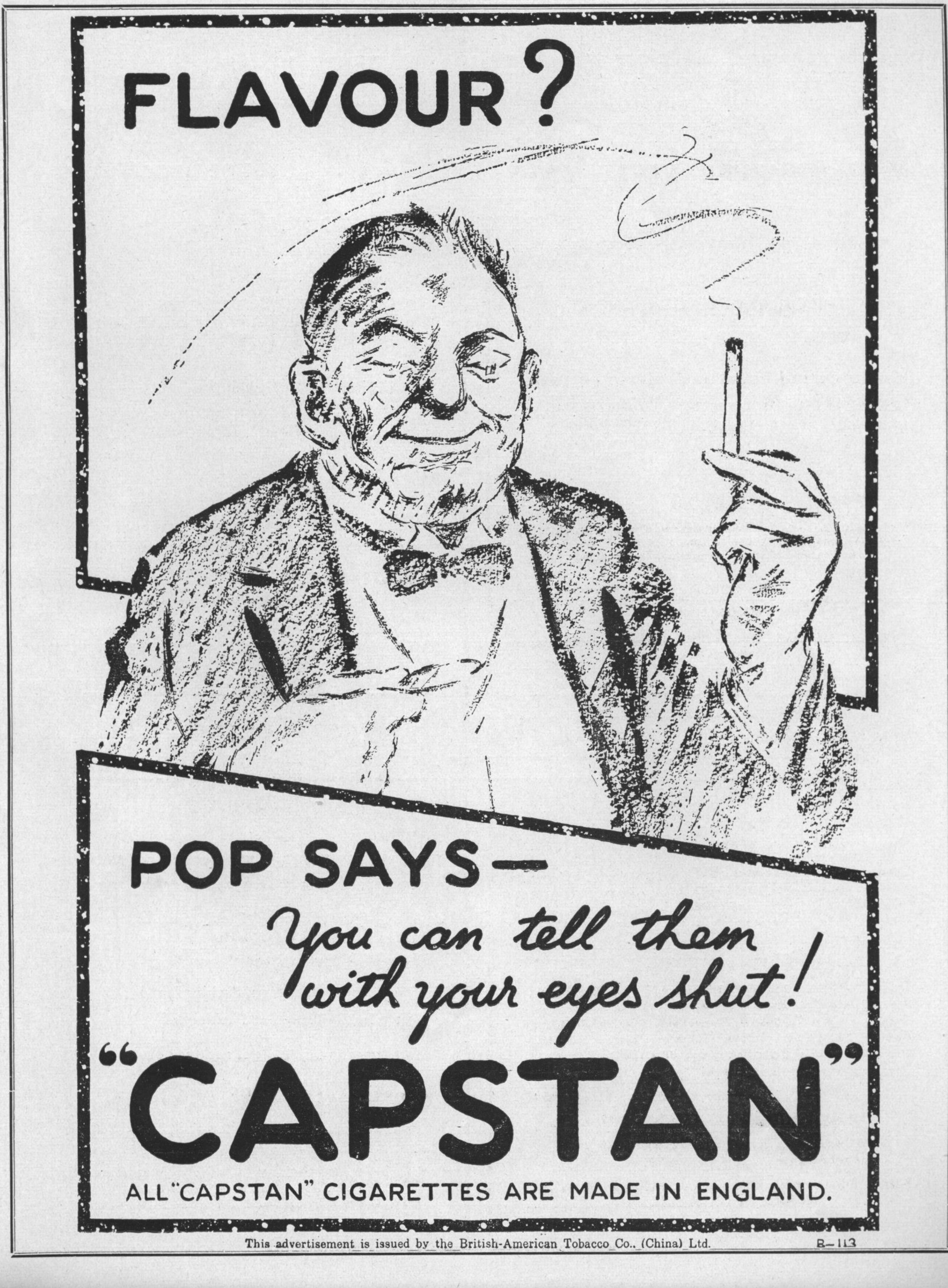
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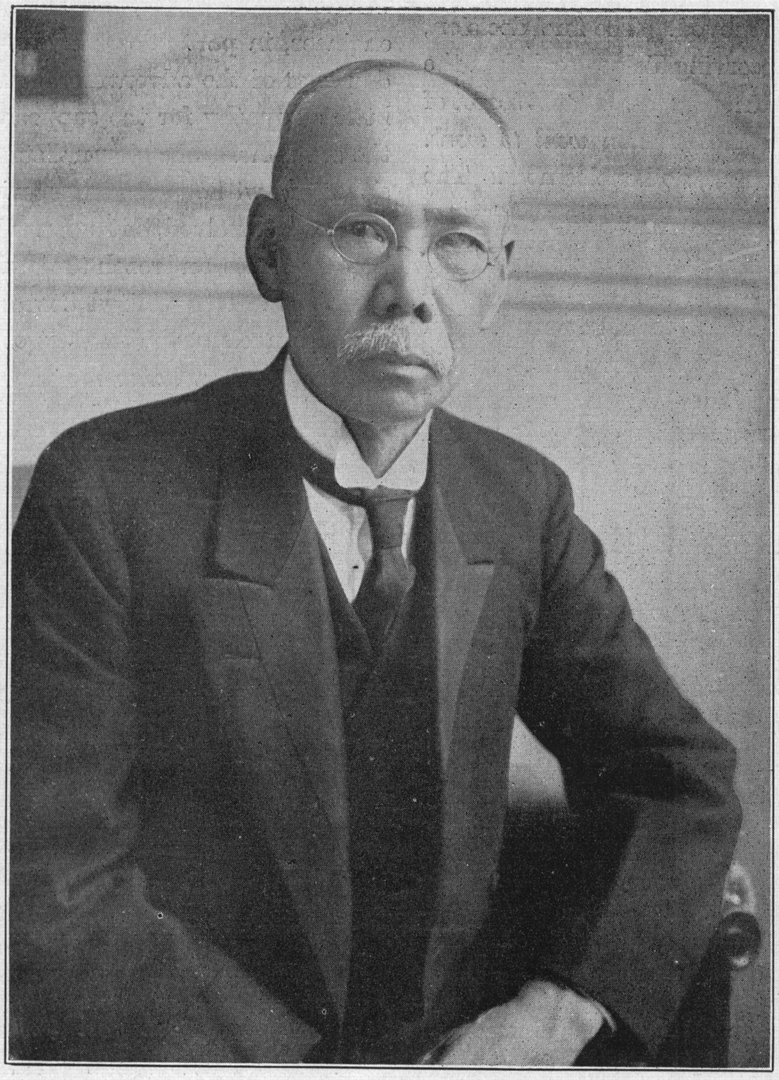
The Far Eastern Review

ENGINEERING FINANCE COMMERCE

VOL. XXI SHANGHAI, JUNE-JULY, 1925 No. 6-7

A Monument to the Japanese Engineer

THE FAR EASTERN REVIEW dedicates this number to the Japanese Engineer, whose monument will ever be the recreation of Tokyo and Yokohama after the terrible earthquake and fires had reduced these cities to veritable dust. The casual person little realizes what it means for a city to disappear and then again to arise out of its ashes. When news of the earthquake flashed across the cable wires to all countries universal sympathy for the Japanese people was engendered. Every nation tried to do its share in rushing assistance to the suffering. The United States was particularly generous in its exhibitions of friendship. Even China, which for years previously had only remembered the political differences between the two countries, was now impelled to show that in distress all peoples of the world are brothers.



The Reconstruction Mayor of Tokyo

MR. ZEKO NAKAMURA

One of Japan's Ablest Executives

From a minor post in the Formosan Government Service, Mr. Nakamura rose to the Presidency of the South Manchuria Railway Company, which post he held for five years during its formative period (1908-13); from there he was called to the vice-Presidency and then to the Presidency of the Imperial Japanese Railways. On the retirement of Mr. Nagata as Mayor of Tokyo, Mr. Nakamura was selected to fill this difficult position during the Reconstruction Period.

After the first flush of the shock of the disaster other peoples quite naturally settled down to their own affairs, and Japan was left with the problem of re-making her capital and her principal commercial port. It was to be a work from the foundations up. What the earthquake and subsequent fires actually did to Tokyo and Yokohama few who were not there at the time can imagine. An eyewitness's account,* written shortly after the event, describes graphically what happened :

> " On Monday we took a trip through the heart of Tokyo. Where shall one begin his description ? Shall it be the electric wires entangled overhead, torn loose, covering the streets ? Shall it be the overpowering odor of burning humanity ? Shall it be the buildings, now heaps of broken stone and wood, still smouldering, still smoking ? Shall it be the gaping crowds, or those picking in the *débris* for the bodies of lost ones ? Perhaps it is not possible to find words to describe these scenes. Perhaps we may pass over the havoc with just one sentence : the heart of Tokyo was gone, nothing was left but a few modern buildings. . . . "

*"Diary of a Fortnight," by George E. Sokolsky in the *North-China Daily News*.

The Spirit Unbroken.

"The heart of Tokyo was gone." That phrase describes the physical condition of Tokyo, the capital of the country. But spiritually, neither the heart nor the indomitable spirit of the Japanese people was gone. Japan faced the earthquake and its aftermath, as Japan has faced her whole history, bravely, patiently, with strength and pride and an unerring certainty that there are qualities in the racial composition of the Japanese people which will preserve that nation from natural and human calamities. The Japanese people immediately settled down to work. Even while the earth was trembling the Japanese were thinking reconstruction and were beginning to clear away the destroyed old for the better new. There was for some time a doubt as to the wisdom of rebuilding these two cities. Some suggested that the capital might be moved. The final decision, however, was for rebuilding and preserving Tokyo, and then the whole nation went to work. Therein, perhaps, lies the secret of the tremendous success of Japan. *The nation went to work.* There was no letting up, no loss of spirit, no hopelessness. The nation went to work, and to-day Japan is building a greater Tokyo, a more beautiful Tokyo than was known before the earthquake. It will be a Tokyo of which Japan might well be proud and of which Europe and America will be proud. For it will symbolize the conquest of Asia by the engineer. It will symbolize the utilization of the most modern engineering and construction methods in the East under the direction of Japanese engineers.

In the following articles an opportunity is provided for the reader to familiarize himself with the work that has been done and is being done to reconstruct the devastated area. Particular attention, however, must be called to "The Reconstruction Budget," which tells the story of the heroic effort of a nation to save itself without imperilling its financial position, without losing its political independence of action. For devastations usually destroy the political safety of a nation, which, once forced to borrow for its reconstruction, finds often enough that it has pawned away its freedom of action. That has *not* happened to Japan. Japan emerged from the earthquake period politically as important as she was at Versailles. To maintain that position taxed every resource, every sinew of the Japanese people. In "The Reconstruction Budget" a detailed statement appears of the capacity of the Japanese people to meet such disasters, but, more important still, it indicates the fiscal strength of the nation, its willingness and ability to preserve the glory of Japan at any honorable cost.

In other articles particular attention is paid to the engineering features of reconstruction and the opportunity is utilized to show how the Japanese engineer is gradually advancing to a position where he can produce as high quality a machine as he formerly imported. At the same time, the work of the foreign engineers in Japan, who assisted, willingly and capably, in this work of reconstruction and who placed their services at the command of their Japanese colleagues, is recited.

The Japanese Engineer to the Fore.

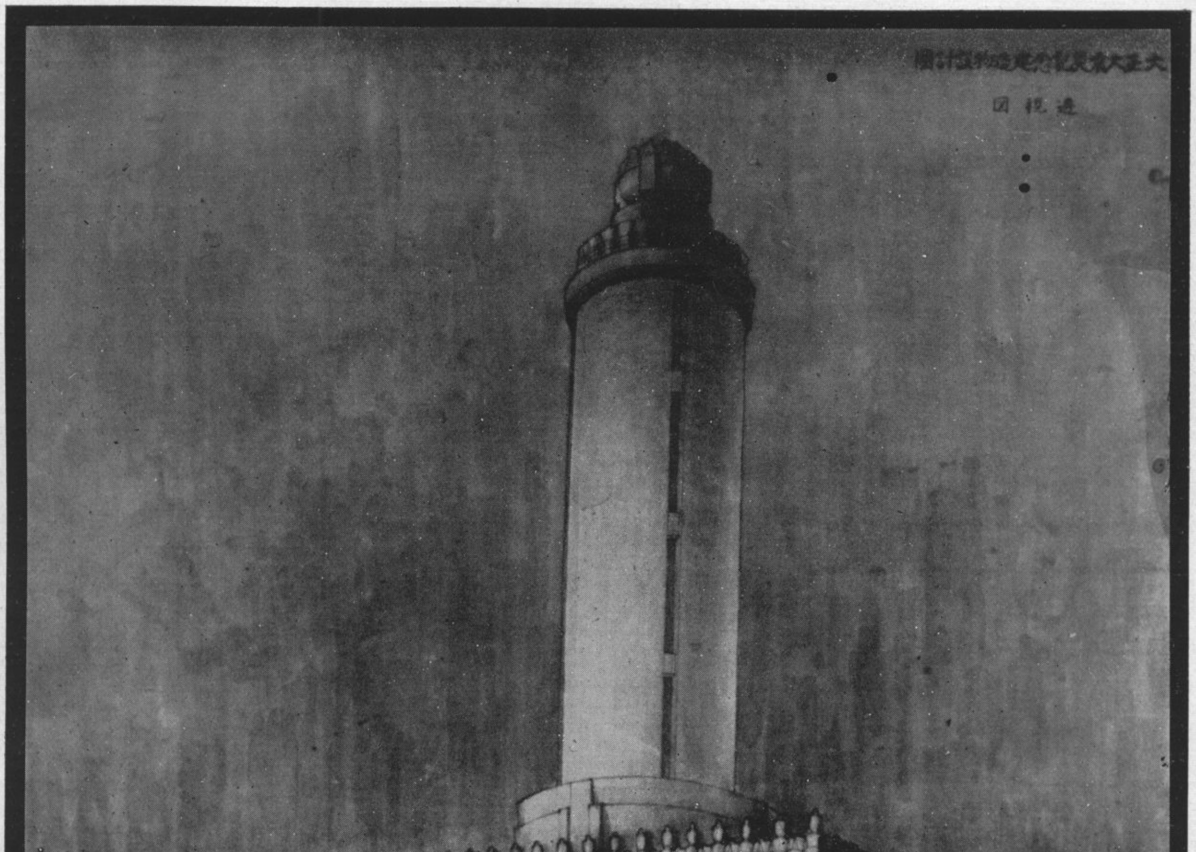
We live in the age of iron and steel, in an age of steam and electricity. It is the era of the engineer. The highest forms of industry are the products of the engineer, and it is perhaps not too bold a prophecy to suggest that when the art of this period is summarized, its finest products will appear in the bridges, the skyscrapers, the monuments of the engineer. To Japan the reconstruction of Tokyo and Yokohama will witness the full entrance of Japan in the fraternity of modern engineering. Japan takes her place among the great engineering nations of the world.

The pages of this number of THE FAR EASTERN REVIEW will describe the work of reconstruction and must present to the engineer, in particular, the hugeness of the task, the tremendousness of the adventure. Engineers deal in facts and have little sympathy for the suppositiousness of the politicians and the scare-mongering journalists, who without knowledge of the situation, without statistics, without a comprehension of the problems involved, hit upon a fact here and there, miss the broader issues, and reach the conclusion that Japan is preparing for a war. The United States suffers particularly from this sort of jingoism, the product of the professional anti-Japanese propagandist, a hater for the love of hating. This type of person, hiding his morbidity under the guise of patriotism, seeks to set two great nations at war for no other purpose than to satisfy the savage insincts of the less civilized elements in both nations, who seek a fight for the sake of the fight.

To the engineer such a war would be a tragedy, for it could only serve to destroy much of the engineering progress of eastern countries. But the engineer has an advantage over the politician and the Hearst journalist in that he is professionally competent to estimate facts and to judge their bearings. When the engineer studies the work of reconstruction now taking place in Japan he will immediately realize that surely the Japanese have no thought of an international war, emphatically not a war with the United States. For the engineer will realize how the full energy of the nation is being consumed in this task of reconstruction, how every possible resource is being tapped to provide the material for reconstruction. The engineer knows what are the works of peace and the works of war. The engineer at a glance realizes which are the nations which are laboring to produce the goods of the world and which are seeking the destruction of mankind. The engineer cannot be frightened by little minds, by meglomaniacs; he deals in facts, and the facts as regards Japan are clear.

Japan wants no war. Japan seeks the friendship of the western nations, particularly the United States. Japan seeks the friendship of China in the hope of mutual economic benefits. Japan wants to have a breathing spell from the intricacies of old-fashioned international politics that she might work out her program of reconstruction. If the nations of the west

In Memoriam



TOKYO'S PLEDGE TO THE DEAD

The design for a Memorial Hall to be erected on the site of the former Military Clothing Depot in Honjo, where 38,000 persons perished in the Great Earthquake Fire. A standing pledge to the living and the dead that, as far as humanly possible, the New Tokyo will be Proof against Earthquake, Fire and Flood. The hall is to cost Yen 1,000,000, to be raised by popular subscription.

do not impose a war on Japan, there will be no war. But will Japan be given this breathing spell, this freedom to solve her internal problems ?

The Ugly Bear.

The answer to this question lies in Manchuria. On the borders of China and Korea, in close proximity to Japan's source of supply for food and for raw materials, lurks the huge and hungry Bear, the historical enemy of Asiatic nations, Russia. Changes may have taken place in Russia, the monarchy has been overthrown and a Soviet Republic instituted, but the international policy of Russia is the same to-day as it was when the Cossack freebooters of Siberia sought to conquer the whole of Manchuria. Russia to-day is seeking to take from China, Manchuria, Mongolia and Sinkiang. Mongolia has already declared its independence of China, but the independence is much like a Napoleonic Cisalpine Republic : Mongolia is free from China, but is attached by intrigue and corruption to Russia. In Manchuria, Russia has thus far been altogether unsuccessful, but the unfortunate weaknesses of the Chinese Government makes every possibility a probability. In West China the Russians are constantly intriguing with the Mohammedan populations against China. Within China itself the Russians reverse their policy, declare for ardent nationalism, subsidize anti-foreign agitations and endanger the position of foreign investments. Russia's policy is altogether without principle, except that there should be disturbances in China, that China should be weak, that China should become the buffer state between Russia and the remainder of the world, and that in the event of an international war China should take the shock of any attack on Russia.

This program is aimed at Japan and Great Britain. Japan, therefore, cannot view without apprehension this effort of Russia to disintegrate China, for Japan's interest in China is not only spiritual and sentimental, it is practical. China, particularly Manchuria, supplies Japan with her raw materials. The unfortunate policy of western nations, that Japanese, as Asiatics, should be excluded from their countries, leaves Japan only with the continent of Asia for emigration and for the production of necessities by her own surplus population. The Russian attitude towards China affects Japan directly. It becomes a life-and-death struggle. It becomes a matter of the rice bowl and the loaf of bread for the masses of the Japanese people. It is not a matter of high international intrigue : it is life itself. If, then, Japan is at any moment forced to forego her work of reconstruction and rehabilitation and to prepare for war, it will not be against the United States or any other Western Power. It will be a defensive war against Russia's aggressions on Asia.

Shall Japan Work or Fight?

But even such a war against the enemy of Asia Japan would avoid, if possible. For every dollar wasted in this war would have to be a dollar taken from reconstruction work ; every man thrown into the field would be a laborer taken off a reconstruction job. Japan has patiently noted Russia's antagonism and Russia's aggressions. In 1919 Japan might have stopped Russia's march into Asia from Siberia, but the Allies said " No ! " The Japanese expeditionary force was recalled. Japan abided by the decision of her western colleagues, and now may at any moment be called upon to pay the bill. Is it not only playing the game for the western nations to recognize what we have always learned to admire in individuals —grit, spirit, the sporting blood ? Is it not fair to expect that the western nations will make such a war an impossibility, will make such a war unnecessary? Soviet Russia, the enemy of Asia, is the foe of peace. Soviet Russia, involved in the chaos of her own economic instability, would drag the whole world behind her. Soviet Russia favors a policy of disturbances in Asia, relying on international jealousies to prevent the nations of the west from joining with Japan in defence of their common interests. Japan is the first objective, and Russia hopes to make China the tool.

The question of the hour in Asia, then, is : Shall Japan have the breathing spell to work out her program of reconstruction or shall Japan be involved in a destructive war on the continent of Asia in defending her vital interests against Soviet Russia ?

The answer lies, perhaps, with the western engineer.

The Shanghai Strike

THE Reconstruction Number of the THE FAR EASTERN REVIEW was to have appeared during June. On May 30, because of a riot which led to the shooting of Chinese by the Shanghai police, a strike took place in all industries involving foreigners, with the result that our printers were unable to print this journal. This strike is still effective in many industries as we go to press, but at the end of July the printers returned to work, and we hope that there will be no further interruption in our efforts to publish a monthly journal of engineering and political opinion on Far Eastern questions.

No reference, beyond requesting our readers and advertisers to pardon the delay in publication, can be made to this incident, and the series of political events growing out of it, in this number, which is limited to the reconstruction of Tokyo and Yokohama. The August number, which we hope may appear on time, will contain a complete analysis of the situation, with special emphasis on the unionization of labor and its effects upon industry.

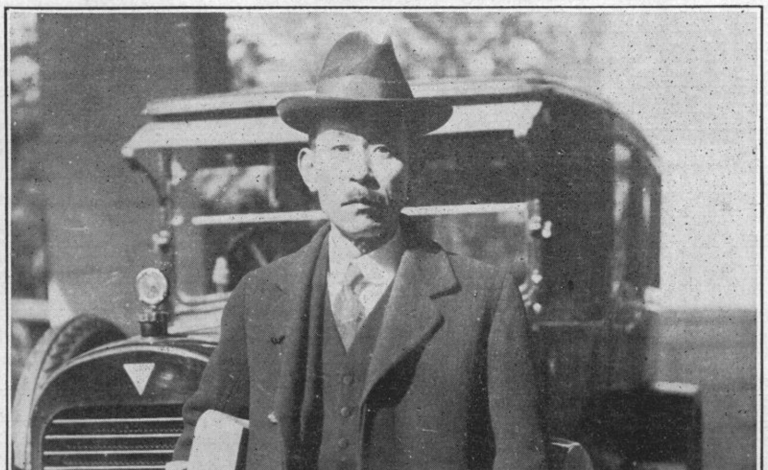
We call our advertisers' attention to the fact that this number is issued as for June and July because of *force majeure* growing out of the strike.

The Reconstruction Budget

The Expression of a People's Determination to Survive and Their Willingness and Ability to Pay

"*Tokyo will remain the capital of the Empire. It will be rebuilt to entirely new plans that will make it in every sense a seat of government worthy of a great nation.*" This, in brief, was the import of an Imperial Decree issued on September 12, twelve days after the great disaster, the answer of the rulers of Japan to the agitation for the transfer of the Imperial palace and administrative center of government to Kyoto.

The old Tokyo, the city evolved from the mediæval stronghold of the shogunate, will disappear. On its ruins a new metropolis is being erected that will take its place amongst the other great capitals of the world along lines that will provide for the needs of a population that in the next two decades is expected to reach seven millions. It required courage to arrive at such a decision before the ashes of Tokyo had had time to cool and in the face of the possibility that another earthquake, more severe than the last, might destroy in a few minutes the labor of years. For a moment, and only for a moment, during the blackest moments of grief and depression following the catastrophe, did the Japanese consider the idea that it might be best to transfer the seat of government to the ancient capital at Kyoto, but the same indomitable will that urged them forward in their record-breaking march of progress for the past sixty years determined their decision to remain and erect a new city that would defy the fires, floods and earthquakes which in the past have exacted their periodical toll of lives and property.



Mr. R. Naoki, head of the Reconstruction Bureau which is responsible for the building of new streets, canals, parks and public markets in the destroyed district

The program for remaking the cities of Tokyo and Yokohama is one of the most heroic demonstrations of human imagination and will to survive that modern history can point to. To carry it through called for such huge expenditures that even a people more favorably endowed with natural resources than the Japanese might well have hesitated before embarking on such a task. In this brave struggle to turn the calamity into a blessing the most important obstacle was the budget, the key to success or failure. It took a long time to arrive at a sane and safe method of financing the great undertaking, and the estimate had to pass through many stages of change and alteration, cut down here and added to there, before the final draft was approved and passed by the Imperial Diet. As it now stands the Reconstruction Budget is not a mere hit and miss compilation of figures drawn up by politicians, but the concrete expression of the most expert minds of the empire, the concentrated wisdom of Government officials, leaders of finance, industry, engineering and sanitation.

The total national and local budget as finally passed calls for Y.741,570,909. There was no guess-work in arriving at this figure. It is the expression of the nation's willingness and ability to pay worked out by a pains-taking investigation of the national resources and the actual detailed costs attached to every branch of the reconstruction work. The budget, as it stands, is a tribute to Japan's soundness of comprehension, the vision and faith of a people in their ability to carry through and complete the task they have set themselves to do.

It would serve no good purpose to recount at this late date the inside history of the Reconstruction Budget. The machinery of government in Tokyo is antiquated, complex and involved, a hold-over from the feudal era, with the powers of state, prefecture and municipality hopelessly intertwined, overlapping and interfering with each other, and the whole overshadowed by the prerogatives of the Imperial Government and the Imperial Household, whose property holdings in the Capital are equal in value to one-third of the total devastated area. It was no easy matter to harmonize these conflicting interests and commit the national treasury to huge expenditures for reconstruction work in Tokyo and Yokohama, especially at a time when the Diet was dominated by a political party deriving its strength from the rural districts. As a consequence, the budget estimates had to pass through many hands before a compromise could be effected in order to insure its approval and enactment into law by the Diet.

On September 27, 1923, the first Reconstruction Board, composed of all the leading men of the nation, was organized, with Viscount Goto, then Minister for Home Affairs, as president. The plan proposed before the organization of this Board was a huge one, calling for an expenditure of Y.3,500,000,000, of which Y.2,000,000,000 were to be expended by the various Ministries for rehabilitation work under their respective departments, and the balance set aside for the reconstruction needs of Tokyo and Yokohama. These original estimates included the railways, canals, harbors, suburban districts and even the government buildings, swelling the total to an enormous figure and concentrating under one board practical supervision over all the other departments of the government. In order to keep the budget as small as possible and leave certain works to be carried out by the departments directly concerned, this tentative plan was therefore abandoned. An entirely new budget was prepared and approved by the committee of officials of the Board on October 23, 1923, in which it was decided to leave the major fundamental work to be executed by the departments concerned under their own budgets, but to include in the general reconstruction plan the Tokyo-Yokohama canal and the Tokyo harbor works. The revised estimates amounted to Y.1,300,000,000. This also had to pass through various meetings of the many interested boards and committees,

The budget, after being approved by the Reconstruction Committee totalled Y.751,000,000, itemized as follows :

1.	Streets and Roads	Y.430,000,000
2.	Canals...	38,000,000
3.	Tokyo-Yokohama Canal	15,000,000
4.	Tokyo Harbor	35,000,000
5.	Waterworks and Sewer System	5,000,000
6.	Subsidy for Fire-proof Buildings	65,000,000
7.	Parks	30,000,000
8.	Land Readjustment	3,000,000
9.	Office Expenses	30,000,000
10.	Yokohama Reconstruction	100,000,000
	Total	Y.751,000,000

In all the discussions over the budget the question of replotting the city became the fundamental issue, as nearly everyone on the various boards were property owners to a greater or less extent. However, they finally accepted the plan permitting the Government to take over ten per cent. of the land necessary for improvements without compensation. With this and other economies the estimate of Y.751,000,000 was reduced to Y.574,816,049 and presented to the Diet in that form on December 11, 1923. Here the Seiyukai Party amended the figures on the ground that the city was laying too heavy a burden on the national treasury, their attitude being sustained by the House of Peers, and this figure became Y.468,438,-849. The following table shows the original estimates as submitted to the Diet and the amendments :

	Original	Amended
1. Tokyo City Reconstruction ...	402,793,000	306,678,400
2. Yokohama Reconstruction	45,777,000	35,514,400
3. Loans to Local Governments ...	15,325,402	15,325,402
4. Subsidy to Local Governments ...	69,225,917	69,225,917
5. Interest to be paid by National Government on Local Government Debts	21,694,730	21,694,730
6. Subsidy for Fireproof Buildings ...	20,000,000	20,000,000
Total	574,816,049	468,438,849

This cut in the appropiations made the execution of the reconstruction plan very difficult, and it was a matter of considerable satisfaction to those interested in the rebuilding of the city to see the dissolution of the 48th Diet, followed by a new election which changed its political complexion. In the next session, which met on June 28, 1924, an additional sum of Y.105,000,000 was approved, which increased the budget to Y.573,438,849. Apart from this, there are Y.168,123,060, which is to be financed by the cities of Tokyo and Yokohama themselves for specific purposes. This brought the budget up to Y.741,570,909, where it stands to-day for carrying out the initial steps in the huge plan of reconstruction.

This figure does not include the expenses for rehabilitation work to be carried out by the various Ministries under their own annual appropriation and earnings. For example, the Government colleges and institutions of learning supported by the State are to be rebuilt by the Ministry of Education, quite apart from the large appropriations under the reconstruction program for primary and other schools supervised by the cities and prefectures. The Railway Department will carry out its own reconstruction and plans for extending its steam and electrified lines. The Department of Communications in the same manner will restore the telephone, telegraph, radio and other work coming under their jurisdiction. The Home and Finance Departments will also finance such works as come under their immediate jurisdiction.

In addition to this, the Hypothec Bank of Japan, a semi-official institution, was authorized by the Diet on July 22, 1924, to issue what is designated as Reconstruction Savings Bonds to the amount of Y.200,000,000, of which half is to be loaned by the bank for the rehabilitation of industries in the destroyed area and the other half loaned at low interest for reconstruction works. Furthermore, a Reconstruction Building Company is in process of organization for the purpose of facilitating the fire-proof construction necessary to carry out the plans of the reconstruction program, and this also is to be assisted by a loan of Y.60,000,000 advanced at the same rate of interest charged the city by the national treasury.

As a matter of fact, the reconstruction estimates are somewhat complicated. The total for reconstruction and rehabilitation of the entire devastated area, including Tokyo, Yokohama and the five prefectures, is approximately Y.1,700,000,000 (Y.1,695,898-067). Out of this, the expenses to be borne by the National Government is approximately Y.1,500,000,000 (Y.1,501,743,152). In this figure is included the cost of all reconstruction work which comes under the jurisdiction of the various departments of the Government, as well as the relief work expenses of Y.24,000,000 (Y.24,181,051).

For the reconstruction of Tokyo about Y.629,000,000 will be expended over a period of five years, all work to be completed by the end of the fiscal year 1928. Out of the billion and a half yen approved for the expenditures of the National Government, one billion yen is to be raised by internal and external loans. Out of the Y.629,000,000 set aside for the reconstruction of Tokyo about Y.180,000,000, about 29 per cent., is to be borne by the city, the rest almost exclusively by the National Government. Even here a large part of the city's share is to be obtained by a loan from the national treasury and the rest from municipal loans issued for public subscription.

Analysis of the total expenditures of Y.741,570,909 reveals that the National Government will pay out of the treasury the sum of Y.342,192,800, and Y.357,683,379 will be borne by the local governments. Then Y.20,000,000 are to be subsidised for fireproof constructions, and Y.21,694,730 are to be aided by the national treasury for the local governments for interest charges.

The amount to be spent by the various local governments in actual construction amounts to Y.357,683,379, of which total the National Government will contribute a direct subsidy to the extent of Y.128,080,917, and the balance (Y.229,602,426) will be borne by the local governments in the following proportions. The amount allocated for Tokyo Prefecture is Y.20,333,204. Of this, Y.7,583,506 (for exclusive road construction) is a direct contribution from the national treasury, and the balance of Y.12,749,698 will be advanced to the prefecture as a loan from the same source. In Kanagawa Prefecture a total of Y.3,318,075 will be expended, of which Y.742,-371 is a direct charge on the National Government and the balance, Y.2,575,704, is a loan from the same source.

The reconstruction expenses of Tokyo as provided for in the budget will total Y.277,443,100. The National Government will bear Y.103,216,707 as its share, and Y.41,743,000 is to be loaned to the city, and Y.132,483,393 is to be raised by municipal loans guaranteed by the National Government up to Y.100,000,000.

The appropriation for Yokohama is Y.56,589,000, of which Y.16,538,333 is a direct charge on the national treasury, Y.4,402,000 is to be loaned by the national treasury to the municipality of Yokohama, the balance (Y.35,684,667) to be raised by municipal loans. The external borrowing capacity of the city of Yokohama (with government aid) is restricted to Yen 40,000,000.

In order that the local governments can meet the interest charges on these various loans (aggregating Y.168,352,462), the National Government will guarantee the payment of interest over the five-year construction period up to Y.17,408,274 for Tokyo and Y.4,286,456 for Yokohama, a total of Y.21,694,730. In addition, the National Government also sets aside the sum of Y.20,000,000 to subsidize the erection of fireproof buildings.

The actual budget as passed by the Diet authorizes the expenditure of only Y.573,438,849. The loans to be issued by Tokyo and Yokohama, amounting to Y.106,882,060, and the advances to the revenue-producing public utilities of both cities, totalling Y.61,-250,000, were excluded. The sum total of these figures is the national and local Reconstruction Expenses and brings the total authorized appropriations up to Y.741,570,909.

A résumé of the reconstruction expenses therefore reveals the following :

National Government		Y.367,640,016
Reconstruction Work ...	Y.197,864,369	
Subsidies	128,080,917	
Interest on Loans	21,694,730	
Fireproof Building Subsidy	20,000,000	
Local Governments		Y.373,930,893
Tokyo Prefecture ...	12,749,698	
Kanagawa Prefecture ...	2,575,704	
Tokyo City	304,441,374	
Yokohama City	54,164,117	
Total		Y.741,570,909

On the loans authorized for the city of Tokyo (Y.132,483,393), up to Y.100,000,000 the National Government will guarantee and also pay the interest on Y.84,983,393 for five years, and of the loans authorized for the city of Yokohama (Y.35,648,667) the National

Government will guarantee up to Y.40,000,000 and also pay interest charges for loans up to Y.21,898,667 for five years. The total amount of interest thus guaranteed by the National Government is Y.21,694,730 : Y.17,408,274 for Tokyo and Y.4,286,456 for Yokohama.

EXPENSES FOR RECONSTRUCTION OF TOKYO BORNE BY NATIONAL GOVERNMENT

Streets and Roads	
Compensation for Land Construction Expenses and Bridges	Y.241,047,524
Underground Works and Miscellaneous ...	16,410,876
Canals	
Compensation for Land and Construction ...	26,864,875
Miscellaneous	1,705,125
Parks	
Compensation for Land and Equipment ...	11,900,000
Land Adjustment	
Executive, Miscellaneous, Purchase and Indemnification	8,750,000
Total	Y.306,673,400

EXPENSES FOR RECONSTRUCTION OF YOKOHAMA BY NATIONAL GOVERNMENT

Streets and Roads	
Compensation for Land, Construction & Bridges	Y.24,487,400
Miscellaneous	895,000
Canals	
Compensation and Construction	5,520,000
Miscellaneous	92,000
Parks	
Compensation for Land and Equipment ...	1,959,000
Land Adjustment	
Executive, Miscellaneous, Purchase and Indemfication	2,561,000
Total	Y.35,514,400
Total for Tokyo and Yokohama	Y.342,192,800

This sum, spread over a period of five years, will be expended in the following annual proportions :
1923 : Y.6,291,800 ; 1924 : 87,607,000 ; 1925 : 68,855,400 ; 1926 : 58,690,800 ; 1927 : 72,235,934 ; 1928 : 48,511,866.

WORK UNDERTAKEN BY LOCAL GOVERNMENTS (TOKYO PREFECTURE)

National Roads and Bridges	9,583,204
Prefectural Roads	7,500,000
Schools	3,250,000
Total	Y.20,333,204

To be expended over a five-year period as follows : 1923 : Y.2,308,006 ; 1924 : 4,670,881 ; 1925 : 4,466,802 ; 1926 : 5,887,515 ; 1927 : 1,500,000 ; 1928 : 1,500,000.

WORK UNDERTAKEN BY LOCAL GOVERNMENTS (TOKYO CITY)

Streets and Bridges, Restoration Work	Y. 16,055,100
Streets and Extensions	60,852,000
Land Adjustment	33,951,000
Water Works	10,000,000
Sewer System	43,500,000
Small Parks	10,000,000
Dirt and Garbage Disposal	1,850,000
Central Market...	15,000,000
Sanitation Equipment	3,100,000
Schools	38,610,000
Social Welfare Works	4,525,000
Electrical Works	40,000,000
Total	Y.277,443,100

The above expenditures are also spread over a period of five years in the following proportions :

1923	Y.14,189,000
1924	62,380,000
1925	65,779,000
1926	62,717,000
1927	40,947,000
1928	31,431,100
Total	Y.277,443,100

TOTAL EXPENDITURE BY KANAGAWA PREFECTURE (Y.3,318,075)

National Roads and Bridges	Y.1,318,075
Schools	2,000,000

This sum is also to be spread over a period of five years in the following proportions : 1923 : Y.400,000 ; 1924 : 1,418,075 ; 1925 : 500,000 ; 1926 : 1,500,000 ; 1927 : 500,000

TOTAL EXPENDITURE BY THE CITY OF YOKOHAMA (Y.56,589,000)

Streets and Bridges, Restoration	Y. 7,442,000
Roads	6,018,000
Land Adjustment	4,179,000
Canals and Rivers	6,000,000
Water Works	3,000,000
Sewer Works	1,250,000
Schools	10,950,000
Social Welfare Works	750,000
Electrical Services	8,500,000
Gas Works	3,000,000
Central Market	4,000,000
Public Health Work	1,500,000

This will also be spread over a five-year period as follows : 1923 : Y.1,781,000 ; 1924 : 12,019,000 ; 1925 : 13,393,000 ; 1926 : 11,873,000 ; 1927 : 9,789,000 ; 1928 : 7,734,000 ; Total, Y.56,589,000.

Analysis of the above estimates shows that the total reconstruction burden on the national treasury is in the neighborhood of Y.1,500,000,000, approximately $700,000,000 gold. This, however, does not mean that all of that sum is to be paid by the National Government. As is clearly indicated, a portion of this represents the National Government's aid to cities, prefectures, towns and villages which were suddenly deprived of the major portion of their normal revenues for taxation. This aid is in the form of loans from the national treasury, the interest being paid out of the capital account for the first few years, or until these communities get back to a normal basis and can redeem or pay the amortization instalments out of their current revenues.

Such aid is purely temporary, and the above figures make no allowance for the costs that must eventually be shouldered by the local governments in carrying forward the necessary improvements and extensions to meet the requirements of a rapidly growing population. Neither do the figures embrace the costs of those important public utility extensions now controlled by private corporations, such as gas, electric light and power, and the lesser tramways and transportation companies who must find large sums in the open market to expand their facilities. Neither does it include that other vitally important undertaking, so essential to the future greatness of Tokyo—the harbor improvement. Nothing here will meet the growing needs of the metropolis but a comprehensive plan spread over a period of years, which will convert the entire foreshore into wharves and warehouses on reclaimed land extending south to where the improvements will dovetail into the work of the Tsurumi reclamation and the Yokohama harbor. The figures make no provision for the new subway construction or many other essential public improvements which cannot be much longer sidetracked if Tokyo is to retain her position as the first city of the empire.

Mere speculation as to the amount of money required during the next decade to carry forward these schemes leads nowhere, but the essential truth is clearly demonstrated that the totals will run into enormous figures. They cannot be set aside. Japan has entered upon a road from which there is no turning. Each year will call for further and heavier financial burdens if the metropolitan district is to develop along lines that will enable its population to exist in comfort and within reasonable living costs.

If Japan is to take her real place in Asia and play out the rôle her men of vision have assigned to her in the drama of history that is rapidly unfolding in the Pacific she must have a capital city commensurate with her greatness. If this capital city is to care for the comfort and health of the millions who will flock to it, it must be modernized from the substructure up in every sense of the word.

Can the city of Tokyo stand the strain ? Will the funds be available ? The city of Tokyo may have to go abroad for funds to carry out its full program for public improvements. Here it stands in a most favorable position. Nearly all of its small outstanding debt is for revenue-producing utilities, such as tram-lines and waterworks. The costs of carrying forward the new program come under the same general head of revenue-producing public utilities, which, when completed and in operation, will not only take care of their own financing but return a handsome surplus to the municipal

treasury. The new subways, waterworks extensions, the harbor improvements, the sewer system, electric light and power are all business propositions, and with the municipal guarantee there should be no difficulty in raising the funds for their construction. In addition to producing revenue, these improvements will automatically appreciate the land values throughout the city and provide its government with the means of increasing its revenues from taxation and its borrowing capacity.

In arriving at any conservative estimate of Tokyo's debt limit, we are met at the outset by conditions arising from the catastrophe which deprived the city of its normal revenues from taxation, resulting in a deficit of Y.11,070,000 in 1923, due to the remission of taxes for those whose properties were destroyed. The 1923-24 budget of Y.39,660,000 is Y.6,320,000 in excess of estimated revenue, traceable solely to the extraordinary reconstruction expenses, which for the next three decades will form the largest item in the municipal budget.

Notwithstanding this handicap, it is estimated that the increase in revenues due to the normal appreciation of property will change the deficit into a surplus by the end of the five-year reconstruction period in 1928-29. By practising strict economy and retrenchment all along the line the normal rate of increase of city administrative expenses will be pared down to five per cent., and by 1928 it is estimated that the revenues will exceed expenditures by Y.1,096,000. By that year the heavy reconstruction work will have been completed. Permanent building operations will be well under way, public utilities extended, and other improvements carried out that will greatly enhance property values and increase the taxing powers of the city.

In the meantime annual deficits will be met during these five years of rebuilding by subsidies from the national treasury and by the issue of debentures. The total deficit for this period will approximate Y.44,788,341, but once the corner is turned in 1928, the next five years are expected to roll up a surplus of Y.78,795,000.

Dr. Charles A. Beard, commenting on Tokyo's borrowing capacity, in his work on the "Administration and Politics of Tokyo," points out that the per capita debt of Tokyo is only Y.80.25 against Y.602 for New York, 111 for Chicago, 331 for Boston and 218 for Philadelphia, and then shows that only 30.2 per cent. of the bonded debt of all American cities of 30,000 inhabitants and over in 1919 had been issued for revenue-producing public utilities and 69.8 per cent. for unproductive undertakings. On the other hand, 85 per cent. of Tokyo's debt is for revenue-producing public utilities and fifteen per cent. for non-productive undertakings.

In determining the borrowing capacity of the city of Tokyo for non-productive revenue purposes Dr. Beard applies the New York rule of ten per cent. on the actual value of the taxable property, which fixes its debt-creating power at Y.337,245,426. Summing up his inquiry into the ability of Tokyo to pay, he places the debt limit of the city at somewhere between Y.100,000,000 and Y.200,000,000.

These conclusions, however, are not intended to be final, as the Tokyo municipal authorities have been guided by the principle that wise city plans increase the value of the land affected by them, and such value forms the basis of the security for the cost of executing such plans. Property values will steadily increase in Tokyo with the growth of the city even if no great improvements are undertaken. This normal increase is entirely apart from special increases due to specific improvements such as subways, sewers, new streets, etc. On the basis of this normal increase it is entirely proper to borrow more money than the present revenues and land values warrant in order to meet existing needs. It would be unwise, as Dr. Beard points out in his Memorandum on the Reconstruction of Tokyo, to limit the amount borrowed now to the small sum guaranteed by the present land values and revenues of the city. This, he contends, would be as shortsighted as a borrowing policy based on the assumption that there is no limit to the financial burden which the city can carry.

A study of the Reconstruction Budget of the City of Tokyo is illuminating when viewed in the light of the above principles accepted by American authorities as the basis of a community's debt-contracting power. We find that the city of Tokyo is authorized to issue loans to the extent of Y.132,483,393. Of this, the National Government will pay or guarantee interest on Y.84,983,393, leaving only Y.48,000,000 on which the city must meet the interest. Further reference to the table also reveals that the municipal borowings are for the purpose of creating the following revenue-producing public utilities, the profits from which will amply provide for their own interest charges, amortization and redemption:

Sewer System (Total cost Y.43,500,000, half paid by the National Government)	Y.21,750,000
Central Market	11,250,000
Water Works Extension	7,500,000
Electric Tramways	37,600,000
Electric Light Supply	2,400,000
Total	Y.80,500,000

So, out of a total of Y.132,983,393 in municipal loans for carrying out the reconstruction program, approximately 40 per cent. (Y.48,233,393) is for non-productive purposes and 60 per cent. for creating revenue-producing public utilities. The National Government also restricted the external borrowing capacity of the municipality of Tokyo for reconstruction at Y.100,000,000, but as yet this privilege has not been taken advantage of.

From this brief survey it is obvious that the city of Tokyo is still far within its borrowing powers, conserving its credit for some definite purpose. It may well be assumed that this will take the form of financing the subway system, and possibly the harbour works, two essential and highly remunerative public utilities. The cost of constructing the 41½ miles of projected subways is estimated at Y.187,000,000, the work to be spread over a period of ten or more years. The harbor program, when definitely decided upon in all its details, will call for further large sums, also spread over a period of years.

Tokyo's recuperative powers and ability to meet the interest on these series of loans out of her own resources without help from the national treasury is best expressed in the following estimates of ordinary revenues and expenditures prepared by the municipal treasurer:

Ordinary Revenue and Expenditures

Year	Revenues Total	Derived from Taxation	Expenditures Total	Deficit or Surplus	
	Y.	Y.	Y.	Y.	
1923 ...	36,314,831	6,368,402	36,314,831	18,953,509	Deficit
1924 ...	20,174,243	8,584,150	30,241,326	10,077,083	,,
1925 ...	23,652,910	10,799,858	30,383,993	6,731,083	,,
1926 ...	27,127,710	13,015,646	32,059,293	4,931,583	,,
1927 ...	30,609,863	15,231,394	32,698,946	2,089,083	,,
			Total	Y.42,782,341	,,
1928 ...	34,196,864	17,447,142	33,000,804	1,096,060	Surplus
1929 ...	46,683,162	28,368,467	35,569,494	11,113,668	,,
1930 ...	51,351,479	31,205,314	38,530,233	12,821,246	,,
1931 ...	56,486,628	34,325,864	41,825,556	14,661,072	,,
1932 ...	62,135,292	37,758,431	45,440,026	16,659,266	,,
1933 ...	68,348,823	41,534,274	45,905,038	22,443,785	,,
			Total	Y.78,795,097	,,

National Finances

When the Japanese Government issued a $150,000,000 loan in the United States the early part of last year, simultaneously with one for £25,000,000 in England, the general impression prevailed that the proceeds of these loans were to be employed for purely reconstruction purposes. This idea has become firmly fixed in the minds of many people in Japan, who, failing to participate in the distribution of profitable orders for such large quantities of materials as the loan total seemed to imply, are wondering what has become of the money. It is well to remember, however, that this so-called Reconstruction Loan was primarily a refunding operation by which the Japanese Government retired the outstanding balance of the 4½ per cent. sterling loan, first and second series, falling due February 15, 1925, and July 10, 1925, respectively. This loan, issued during the Russo-Japanese war in 1905, was for £60,000,000, and up to last year the Japanese Government had retired about £25,000,000, or 40 per cent., leaving outstanding bonds equivalent to $170,500,000 gold par value. The object of the new loan was to call in these outstanding bonds for redemption on October 1, 1924, and clear the way for the reconstruction program forced on the nation by the earthquake and fire of September 1, 1923.

It was estimated that the reconstruction program of the Japanese National Government would call for the expenditure of Y.1,500,000,000 ($700,000,000), of which about half ($350,000,000)

RECONSTRUCTION BUDGET FOR CITY OF TOKYO

Construction Items	Total Expenses	Expenditures for Fiscal Year: 1923-24	1924-25	1925-26	1926-27	1927-28	1928-29	Source of Funds: Amount of National Subsidy	% of Total	Loans from Nat. Govt.	Municipal Loans: Amount	Municipal Loans: Interest Paid by N. G.	Railway Board
Roads and Bridges	16,055,100	600,000	3,500,000	3,000,000	3,000,000	3,000,000	2,955,100	6,689,625	5/12	—	9,365,475	9,365,475	—
Sewers	43,500,000	1,500,000	8,400,000	8,400,000	8,400,000	8,400,000	8,400,000	21,750,000	½	—	21,750,000	21,750,000	—
Parks	10,000,000	950,000	1,900,000	1,900,000	1,900,000	1,900,000	1,450,000	3,333,332	⅓	—	6,666,668	6,666,668	—
Garbage Disposal	1,850,000	—	600,000	600,000	650,000	—	—	462,500	¼	—	1,387,500	1,387,500	—
Central Market	15,000,000	—	4,500,000	5,250,000	5,250,000	—	—	3,750,000	¼	—	11,250,000	11,250,000	—
Primary Schools	38,610,000	—	8,000,000	8,000,000	8,000,000	8,000,000	6,610,000	9,652,500	¼	—	28,957,500	28,957,500	—
Charity Hospitals	600,000	—	350,000	250,000	—	—	—	775,000	¼	—	2,325,000	2,325,000	—
Dispensaries	2,500,000	—	1,000,000	500,000	500,000	500,000	—						
Social Welfare	4,525,000	—	900,000	925,000	900,000	900,000	900,000	1,243,750	½* ¼*	—	3,281,250	3,281,250	—
Total	132,640,100	3,050,000	29,150,000	28,825,000	28,600,000	22,700,000	20,315,100	47,656,707		—	84,983,393	84,983,393	—
Streets and Roads...	67,531,824	1,290,000	11,237,965	15,737,965	18,609,965	11,403,965	9,251,964	30,426,000	½	30,426,000	—	—	6,679,824
Land Adjustment	33,951,000	849,000	8,328,000	12,252,000	8,343,000	4,179,000	—	22,634,000	⅓	11,317,000	—	—	—
Total	101,482,824	2,139,000	19,565,965	27,989,965	26,952,965	15,582,965	9,251,964	53,060,000		42,743,000	—	—	6,679,824
Water Mains Repairs	5,300,000	3,000,000	1,003,574	1,083,624	212,802	—	—	2,500,000	¼	—	7,500,000	—	—
Water Works Extension	4,700,000	—	1,996,426	1,916,376	787,198	—	—						
Total	10,000,000	3,000,000	3,000,000	3,000,000	1,000,000	—	—	2,500,000		—	7,500,000	—	—
Electric Tramways	37,980,000	—	19,580,000	13,000,000	5,400,000	—	—	—		—	37,980,000	—	—
Electric Supply	2,520,000	—	1,510,000	1,010,000	—	—	—	—		—	2,520,000	—	—
Grand Total	284,622,924	8,189,000	72,805,965	73,824,965	61,952,965	38,282,965	29,567,064	103,216,707		41,743,000	132,983,393	84,983,393	6,679,824

* ½ for Employment Agencies; others ¼.

would be used for the purchase of materials and supplies, a large proportion of which would come from abroad. Now the Japanese Government and the Bank of Japan have bank deposits and short-term foreign Government securities in New York and London aggregating over $250,000,000, or more than sufficient for retiring the sterling bonds when they fell due, but this course obviously would have left only $80,000,000 on deposit abroad with which to finance the purchasing of reconstruction materials.

The two loans netted the Japanese Government approximately $230,000,000, enabling it to retire the $170,500,000 sterling obligations and leave a balance of some $59,500,000 to be added to its cash deposits in New York and London. The net result of the operation therefore increased these reserves to about $310,000,000, or the amount necessary to finance the large purchases of reconstruction materials. The external debt of Japan was not increased to the full amount of $270,000,000. It simply added another $100,000,000, or say Y.200,000,000, to the total outstanding external debt, which at the time of issuing the new loans stood at Y.1,320,624,818, thus raising this figure to about Y.1,520,000,000. In other words, the new loans did not materially increase Japan's financial burden. As a matter of fact, during the past ten years Japan has reduced its external debt by more than Y.325,000,000, and even after adding the new issues, the external debt of the nation is less than the amount that was outstanding on March 31, 1914. This, in itself, is a remarkable showing, due perhaps to the unprecedented prosperity as the result of the war. It indicates, nevertheless, that Japan's sound financial position is not materially impaired as a result of last year's operations. She is better equipped to face the heavy task that looms ahead in carrying out her program of reconstruction.

Over one quarter of the national debt of Japan is self-supporting, the profits from the State railways alone being more than ample to take care of the interest and redemption of her outstanding foreign indebtedness. The State railways, comprising over 7,000 miles, were valued at cost of construction or purchase, at the end of 1923 at over Y.2,100,000,000. The railway accounts are carried independently of the general budget and show for the past fifteen years a substantial profit after payment of all expenses and interest charges. This profit is invested in the improvement or extension of the State railway system. The net profits for the fiscal year ending March 31, 1924, were approximately Y.120,000,000.

The total outstanding domestic obligations of the Japanese Government on July 1, 1924, was Y.3,184,029,109, and of this some Y.540,000,000 represents railway obligations, which carry themselves. In contrast to this and the external debt, the Japanese Government owns State forests, harbor works, telegraph and telephone systems, public buildings, special funds and other investments, all aggregating in excess of Y.12,000,000,000 in estimated value at the present time. The total wealth of the Japanese people at the end of 1921, including public wealth, has been estimated by the Government at close to 100 billion yen, or over 21 times the total indebtedness of the Government. This is considerably more favorable than the relation between the national wealth of the United States and the total debt of its Government. Interest charges on the general debt of the Japanese Government as estimated in the current budget amount to less than 12 per cent. of the Government's ordinary revenues. During the past fifteen fiscal years the Government has retired an average of over Y.39,000,000 of its debt annually by means of a statutory amortization fund, the appropriation for this purpose in last year's budget being Y.42,000,000. According to statute, at least 1.16 per cent. of the Government's funded debt (and not less than Y.30,000,000 in any event, must be retired each year.

The revenues of the Government rest on a broad basis of taxation. In 1922-23 over 62 per cent. of the ordinary revenues of Y.1,428,206,000 were derived from taxes. An income tax of practically universal application, with rates ranging from ½ of 1 per cent. to 36 per cent., produced the largest single amount, Y.229,132,000. In the total ordinary revenues for 1924-25 the income from taxes, excises, etc., is placed at Y.711,937,000. The Government undertakings, such as postal, telephone and telegraphs, State forests and monopolies, bring in Y.333,786,000, while from other sources are derived the additional sums which bring the total ordinary revenue for the year up to Y.1,214,988,000, a shrinkage of a little over Y.200,000,000, due to the earthquake and fire.

(Continued on page 281.)

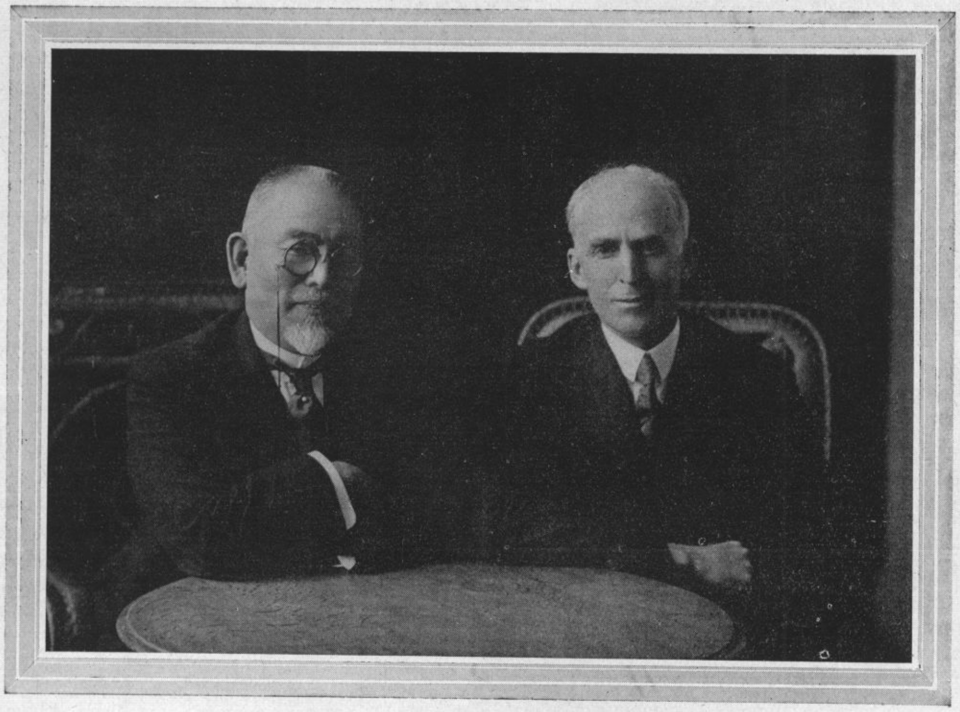
Memorandum Relative to the Reconstruction of Tokyo

Presented to Viscount S. Goto by Charles A. Beard

I. New Street Plans

THE subject of street planning in Tokyo had been carefully studied by the Home Office Bureau of City Planning, the Provincial Committee on City Planning (under the law of 1920), and the Research Section of the City Government. The character of the data to be used had been agreed upon and the general outline of comprehensive plans had been made by engineers and technicians. These plans have been reviewed since the disaster by engineers and technicians from the Reconstruction Board and the City Government. I have held many conferences on the economic aspects of the plans with the representatives of both agencies.

The principles controlling such plans are clear: (*a*) the requirements of the capital as a civic centre must be met; (*b*) street plans must be made with reference to the economical transportation of goods and passengers; (*c*) better fire protection must be afforded by wide streets and park spaces; (*d*) it is more important to provide numerous small parks and places of safety in residential districts than to make streets of extra width; (*e*) the narrow alleys in the old congested districts of the city must be abolished immediately by application of a general rule that no houses shall be built on streets of less than two ken or more in width; (*f*) in all streets in which the traffic will be heavy allowance shall be made for sidewalks for pedestrians; (*g*) street plans must be adjusted to the provisions made for railway terminals, markets, and other public services; (*h*) street plans must be related to subway development and street car line extensions; (*i*) street plans must be related to proposed zoning for industrial, commercial, and residential purposes; (*j*) street plans for the burnt area must be related to plans for the entire area of Greater Tokyo; and (*k*) street plans in connection with rapid transit must be arranged to facilitate the transfer of a large population from the former congested area to outlying regions.



Viscount Goto and Professor Beard

On the street lines it is necessary to realize these principles; both Imperial and Municipal engineers are in general agreement, because they employ the same statistical, engineering, and topographical data. The technical and engineering work of plotting these streets is entirely outside my competence. That calls for old and experienced Japanese engineers and architects familiar with the topography, industrial and business economy, social habits, and artistic taste of the capital. I am deeply impressed, however, by the immense amount of labor which has been spent by your technicians in the study of their peculiar problems.

II. The Land and Housing Problem

Every important aspect of this question has been the subject of earnest inquiry and discussion. The worst slum areas of old Tokyo are now laid waste, and this is the appointed time to prevent their restoration. The experience of the western world shows that the housing problem cannot be left to the tender mercies of landlords unrestrained by social requirements. If it is, slums, misery, disease, and degradation inevitably follows. The whole tendency of western thought and practice is against the unrestricted private ownership of land for housing purposes. With the numerous experiments in munipcial housing in England and Germany Japanese students are familiar. A number of workmen's dwellings had been completed in Tokyo before the earthquake. Osaka is now making interesting progress in this sphere. Thus Japan herself has precedents.

Some German cities own as much as eighty per cent. of the land within their boundaries. These cities keep down land values, rents, and the cost of living by careful administration of their land. This is the time for Tokyo to acquire large areas for industrial housing to be undertaken by public authorities or by private associations with or without Government aid. In addition there should be enacted a carefully drawn law controlling the use of land for housing in the interest of health and safety.

III. Legal Adjustment of Rights

With reference to this point I cannot do better than to refer to the notable example set by England after the great fire of 1666. Parliament passed one of the most remarkable laws in the history of legislation (18 and 19 Charles II., chap. 7). It stands out as a tribute to the genius of the English for arriving at practical methods for meeting difficulties as they arise.

This Act of Parliament created a court of fire judges whose duty it was to make adjustments in all cases of controversy arising out of the calamity which fell on London.

The elements of the Act are as follows:

1. The fire court was empowered (*a*) to sit without any of the formalities of the ordinary courts, (*b*) to examine witnesses, (*c*) to require the attendance of parties, (*d*) to issue orders, and (*c*) to render judgements.

2. The court had the power (*a*) to cancel existing agreements and contracts, (*b*) to substitute new agreements and contracts, (*c*) to order new leases put into effect, and (*d*) to extend the term of leases to not more than 40 years.

3. The principle upon which the court was to act was summed up in brief form in the preamble of the Act: "It is just that everyone concerned should bear a proportionable share of the loss according to their several interests."

The practical application of this general principle took the following forms:

1. If the tenant or leaseholder had been ruined in fortune by the fire and could not resume business, the court cancelled his lease, and in some cases required the landlord to pay him a small sum of money in return for cancelling his claims.

2. If a tenant was ruined in fortune or badly impoverished, the landlord was forbidden to compel the tenant to restore the burned or damaged building.

3. If a landlord suffered great damages in the fire and could not restore the building on the old terms, the court cancelled the old lease and required the tenant to assist the landlord by paying an increased rental.

4. If the landlord was without money to restore his building, the court gave the tenant the power to rebuild and compensated him by granting him an extension of his lease and a reduction in rent.

5. If neither landlord nor tenant was able to rebuild within a period of three years the city government was empowered on the nine months' notice to seize the land and sell the same, handing the proceeds to the parties entitled to such proceeds.

IV. The System of Transportation

I have not found anywhere among your technicians any dissent from the proposition that provision must now be made for the unification of railway terminals with subsidiary stations, and that a system of rapid transit must be provided. Western experience shows that the transportation problem should be treated as a unified problem, involving steam and electric railways, street car lines, busses, rapid transit lines, and traffic regulation. The electric bureau of the city of Tokyo is thoroughly alive to the significance of this fundamental fact.

There is general agreement also on the proposition that subways offer the best solution for the problem of rapid transit. On this point I have nothing to add to my first report, except that this is the time to act, because a large part of the subway can now be built in new streets by open cut, saving an enormous sum of money. If the Imperial Government or Municipal Government is prepared to finance the construction of subways, that is the quickest way of solving the problem. If neither Government is prepared to take the risk, then the next method offered is that of co-operation with private capitalists. The subway contracts in New York show how to effect that co-operation. Care must be taken, however, to avoid some of the mistakes of New York.

V. Priority in Work of Reconstruction

There is substantial agreement among us as to the order in which the work of reconstruction should be undertaken. The first consideration should be the restoration of the economic and home life of the devastated area. This means the complete establishment of street, park, and public building sites in detail at the earliest possible moment, in order that private builders may begin their work of permanent construction immediately. Revenue-producing utilities, such as water works, electric light and power equipment, street railways, etc., should be restored as rapidly as possible to full earning capacity. This should be done as a public service to the people and with a view to improving the financial condition of the city. Public assistance in housing construction already begun while you were Mayor of Tokyo should be renewed and extended at the earliest practicable moment. The reconstruction of school buildings, especially for the elementary and middle schools, should be put on the preferred list.

Permanent official buildings, monuments, the development of parks, the construction of permanent markets and works of an ornamental or aesthetic character should be put last in the program of rebuilding.

VI. Machinery for Action in Reconstruction

The controlling principle here is: "What agencies already existing for construction work have demonstrated a certain degree of ability in their respective fields?" The task of assembling skilled engineers and workmen and collecting materials for construction is a difficult one at best; hence it is not desirable to create any new agencies for operation except in fields not well occupied.

In view of the above principle, I suggest the following: (*a*) that all existing construction agencies of the Imperial and Municipal Governments be utilized to the full, and strengthened by special assistance; (*b*) that the Reconstruction Board confine itself largely to laying out streets, parks and building sites, the purchase of materials in large lots, and construction work in which Japanese engineers have had little or no experience. That special construction work includes subways, street paving, and modern steel and concrete buildings. Improvements and replacements of this character, I respectfully suggest, should be put in the hands of established and experienced contractors working under heavy bond according to approved specifications. In the case of pavements the contractors should be bound to maintain for a period of years on fixed terms.

VII. Open Bidding on Materials

Inasmuch as the purchase of supplies and the letting of contracts involve large amounts of money, it is necessary to surround these operations with the closest safeguards. Therefore I recommend the following:

1. The preparation of standard specifications for each group of supplies and for each important contract.

2. The wide advertising of each great purchase to be made and each contract to be let.

3. The reception of bids at a given time and place from all responsible parties, offering proper bond for the execution of tenders, if and when accepted.

4. The opening of bids in a public room in the presence of any and all bidders who care to send representatives.

5. The award of orders and contracts to responsible parties offering the most favorable terms.

6. The publication of specifications, offers, and awards.

In the way of assistance in perfecting the technique in this field, I have presented to you copies of the specifications, forms, and rules used by the government of the city of New York.

VIII. Building Construction and Design

This is a matter outside my province. However, at your request I have prepared a digest of American engineering opinions with respect to the effects of the San Francisco earthquake and fire on construction. Moreover, I have had occasion to consider the administration of the building code as a part of municipal administration in general. Inevitably also I have informally discussed the problem with Japanese and foreign engineers as well as with public officials.

There seems to be general agreement among them all that there are types of construction that will resist with a high degree of efficiency earthquake shocks such as occurred in Tokyo. They lay stress upon facts obvious even to laymen like myself · first, that steel-frames and re-inforced concrete stood the shock well on the whole, but that the walls of some steel buildings were badly shattered and that some re-inforced concrete buildings collapsed; secondly, that some brick and stone buildings near to badly damaged buildings of steel and concrete came through the shock with hardly a crack, while others quickly fell down—a heap of ruins. These experts also emphasize a fact noted by competent engineers in San Francisco, namely that the protection afforded to fire-proof buildings may be utterly defeated by permitting the erection of inflammable buildings nearby or in their midst.

In view of these circumstances there seems to be a general concensus of opinion among engineers that emphasis must be laid on (*a*) foundations of an approved character, (*b*) proper design adapted to uses and stresses, (*c*) modern fire-proofing, (*d*) segregation of fire-proof buildings, and (*e*) carefully supervised construction according to approved specifications. These I offer as the reflections of a layman derived from expert engineering opinions.

I also venture to offer two other suggestions in this connection. First, that the Reconstruction Board take advantage of the special studies already made by the Buildings Bureau in the Police Commissioner's office. The Buildings Bureau had already prepared a fire code, which was pronounced excellent by Mr. William A. Bassett, consulting engineer of the New York Bureau of Municipal Research, who has had wide experience in the field of administrative control over fire hazards. In the second place I suggest that before the new stipulations as to building zones and regulations are adopt-

ed, they should be published in draft and a public hearing held with a view to obtaining the widest possible concensus of opinion as to precautions against fire and earthquake hazards.

IX. Financial Problems

This subject may be treated under five heads :

1. Financial condition of Tokyo previous to the disaster.
2. Basis of future security for revenues and loans.
3. Basis of contributions from the Imperial treasury.
4. Methods of meeting cost of street improvements.
5. Character of the loans to be floated.

1. As to the first point, it is fortunate that Tokyo previous to the earthquake and fire was unlike all other great cities in the world in that it had a very small debt as compared with the values of real estate (land and buildings), namely, Y.174,307,132. Moreover, nearly all of that debt was for revenue-producing utilities, such as waterworks and street car lines. The total debt for non-revenue-producing purposes was only Y.26,281,772. The waterworks and street car lines are rapidly approaching a paying basis again, although large outlays are necessary for new equipment. Hence it follows that, relatively speaking, the city's financial condition is sound. Nevertheless, great burdens now fall upon it at the time when revenues from taxation are depleted. Hence the financing of improvements must proceed cautiously.

2. There are two outstanding facts with respect to the basis for future security for revenues and loans. The first is that wise city plans, made with reference to the economy, safety, and convenience of the city, increase the value of all lands coming within the range of such plans. The second is that plans for the future must be based on the justifiable assumption that there will be a great increase in land values as the city grows in industry and population.

Examples of the increase of land values due to public improvements are numerous, but one or two instances may be cited by way of illustration. During the period of sixteen years after the laying out of Central Park in New York City, the general increase in land values throughout the city was 100 per cent., while the increase in the value of the land in the wards immediately adjoining the park was 800 per cent. A more notable instance is that of the New York subways. The increase in land values along the subway in Upper Manhattan and the Bronx within seven years after the beginning of operation was more than six times the cost of building that part of the subway.

This great principle is therefore established on the basis of experience : *Wise city plans increase the value of the land affected by them, and such value forms the basis of the security for the cost of executing such plans.*

The second great principle is that land values will steadily increase in Tokyo with the growth of the city even if no great improvements are undertaken. This may be called the " normal increase " which is entirely apart from special increases due to specific improvements such as subways and sewers. *On the basis of this normal increase it is entirely proper to borrow more money now than the present revenues and land values warrant in order to meet existing needs.* In this case the amount set aside for amortization or redemption of loans should be small for the first five years and then gradually increase with the steady rehabilitation and growth of the city. According to this principle it would be unwise to limit the amount borrowed now to the small sum guaranteed by the present land values and revenues of the city. This would be as short-sighted as a borrowing policy based on the assumption that there is no limit to the financial burden which the city can carry.

3. Basis of subsidies from the Imperial treasury. Who should pay the bills of reconstruction ? That is a thorny question if looked at selfishly. Certain groups in Tokyo wish to throw the whole burden or the major portion of it on the National Treasury. Certain groups outside of Tokyo wish to place the burden on the city. Both are wrong. There are principles of justice and equity which can be applied here, principles which should command the assent of all thoughtful citizens.

In the first place it will surely be agreed that Imperial, Prefectural, and Municipal buildings should be restored by the Imperial, Prefectural, and Municipal Governments respectively.

In the second place, all new streets and avenues laid out mainly with a view to enhancing the beauty or serving the needs of the capital of the Empire should be paid for by the Empire.

In the third place improvements made with reference to the uses of Tokyo as a business, industrial, and residential city should be paid for in large part by special assessments on land benefitted and by the city treasury.

As to the apportionment of the burden of cost in cases in which both a city and a capital are served by the same improvements, certain principles have been worked out in Western theory and practice. This point is covered in my first report, but I summarize the principles here :

(*a*) The Imperial Government and the Imperial Household are large owners of land within the city. The total area of taxed land in the city is 11,547,019 *tsubo* ; the total area held by the Imperial Government and Imperial Household is 4,190,511 *tsubo*. The streets adjoining Imperial property must be built, repaired and lighted. Other improvements must be made for it just as for private property which is taxed. On the principles of justice, the citizens of Tokyo should not be compelled to pay taxes to maintain municipal improvements which mainly serve the Imperial Government and the Imperial Household. Moreover, there are thousands of Imperial officers in the city. They use the streets and improvements of the city for the transaction of Imperial business. On the basis of strict justice, therefore, the Imperial treasury should pay a large part of the current expenditures of the city and a large part of the cost of improvements. In the case of the American capital, Washington, the national treasury of the United States pays about one-half of the principal expenditures of the entire city.

(*b*) If special assessments are laid on private landowners to pay for specific street improvements, then special assessments should be laid on Imperial lands adjoining such improvements.

(*c*) Whenever a new street is cut or an old street is widened in order to make an approach to an Imperial building, then the Imperial Government should pay the entire cost.

(*d*) Imperial subsidies for social work, education, etc., should be apportioned among all cities, towns and villages on the same principles, that is, on the basis of population, or some other uniform rule.

Surely no one can question the justice of the above principles. If they are fairly applied in the present emergency, justice will be done to both parties, that is, Tokyo and the nation.

4. Methods of meeting the cost of street improvements. In view of the fundamental fact that wise plans increase land values, all modern city planners agree that a large part of the cost of executing such plans should fall upon the owners of the property benefitted. This is the only possible way in which money can be secured to reconstruct Tokyo and provide it with the conveniences and necessities of modern life.

Financing on the basis of increments in values may take one of several forms. The most popular system in the United States is that of " special assessments," or taxes laid upon the owners of land adjoining public improvements. Japanese law already makes provision for a limited application of this principle in the case of street improvements. Since a beginning has been made, it may be readily extended. This subject is discussed in my " Collected Addresses," and in a pamphlet issued by the National Municipal League, both of which have been translated into Japanese.

The second method is that known as " excess condemnation," which has been extensively used in France and England. In such a case, the Government condemns more land than is necessary for the particular improvement and then re-sells the remainder or leases it in such a manner as to make gains from the increments in values caused by the improvement.

A third method is Municipal ownership of land on a large scale. This practice is widely adopted by German cities, which derive large sums from ground rents and control the distribution of the population. Such financing calls for large initial outlays, but by careful management such undertakings produce revenues which meet both interest and amortization charges.

A fourth method is that employed in some German cities and recently adopted with modifications in the replanning of Salonica after the great fire. Under this plan the entire area to be reconstructed is condemned and taken by the Government. The owner of each lot is given a certificate equal in amount to the value of his land. The new streets, parks, and building sites are laid out. New lots of land are laid out. The new lots are then distributed among the former owners or sold at auction to the highest bidders, preference being given to the former landowners. This may be combined

with subventions from the Muncipal treasury to pay in part for the land taken for new streets, parks, and building sites.

It may be found desirable to apply two or more methods to financing the street plans of Tokyo. Therefore the following practical suggestions have been offered with a view to securing wide streets at a minimum cost to the Imperial and Municipal Governments :

Decree by law that in certain sections twenty per cent. of all lots of land above a certain size shall be taken for widening streets without any compensation to the owners, and that certificates of indebtedness bearing six per cent. interest shall be issued to the owners of lots too small for use after twenty per cent. has been taken for streets. Such certificates in each case shall be for the present market value of the lot, and they shall be paid in cash or permanent bonds at the expiration of five years.

This method is the best of all if it can be adopted, for it saves the great expense and difficulties involved in valuation, condemnation, and resale. It is the cheapest, for it calls for a very small outlay of money immediately. It is the most just, for it places the principal cost on the property benefitted.

If in some districts it is not possible to apply this principle, or if the law prevents, then the principle of special assessments can be applied without adding materially to the Imperial or Municipal debt. Apply this method in the following manner :

Lay out the new street. Create on both sides of it a special assessment district. Charge against this district a certain part of the cost of the new street. Issue special assessment bonds as mortgages or first liens on the land within the district. Provide that the interest and redemption of such bonds shall be met by annual taxes laid upon the owners of land within the district. In order not to burden these taxpayers until they have had an opportunity to re-establish their homes and business, it may be provided that the interest and redemption installments for the first five years shall be met by the Imperial treasury on the principles laid down above for the apportionment of costs between the Imperial and Municipal Governments and private landowners.

There is still another method by which smaller streets may be widened. That is direct law forbidding the erection of buildings on any street which is not two or more ken wide. At present the law provides, I am informed, that no new building shall be erected on a street which is less than one and a half ken wide (nine feet). This law could be easily changed to read two or more ken, but in such case a study should be made of its effect upon the owners of small lots. Compensation might be made in case the amount taken exceeds a certain fixed proportion of small lots.

Finally there is a last resort, in case all others fail. That is to decree that no lot owner shall build any structure within five or ten feet of the present street line. In this case the Government does not take any land from the owner. It simply forbids him to build on the front part of his lot. In this case, however, the Government is not permitted to build a street or sidewalk on any part of owner's land. It merely reserves a part of each lot to the public. When the finances of the Government are in a better condition it may then condemn the land reserved in the front part of the lots and use it for streets and sidewalks. At that future time it will not be compelled to pay for tearing down any buildings to make room for street widening. At most it will merely be compelled to pay for the land actually *taken*, and at that time it may recover all or part of the purchase-money by levying special assessments on the district benefitted.

This method is sometimes applied in the United States with excellent results. It is one way of securing quick action at a small financial outlay. It can be applied, however, only to the widening of existing streets. It is not applicable to the cutting of new streets or to cases in which a large portion of all the land on both sides of an existing street is taken.

5. As to the character of the loans to be floated, I offer the following suggestions. First, that no large general loans be floated either at home or abroad. Secondly, that the loans to be floated be divided into two classes : (*a*) loans for specific undertakings which will produce revenues, such as waterworks, street cars, etc., and (*b*) loans for public buildings and works necessary to the transaction of public business. Loans of the first class, guaranteed by the Imperial Government and supported by detailed specifications as to uses and earning capacity, would meet with a favorable reception abroad, especially if the proceeds are spent in purchase of materials for revenue-producing works. Loans of the second class should be floated in the domestic market if possible.

Perhaps a word may be said with respect to emergency loans. The devastated cities and villages have suddenly lost the major portion of their normal revenues from taxation. It will be necessary for the Imperial Government to aid these local governments. Direct gifts and subsidies will raise political controversies. Therefore loans will be better in such circumstances. In making these loans it could be stipulated that during the first two or three years the interest shall be paid out of the capital account, and that as soon as the restoration of normal life permits the redemption or amortization installments as well as interest shall be paid out of current revenues.

X. A Definite Financial Plan and Its Economic Basis

In order to give precision to the above principles I venture to suggest a somewhat concise scheme of financing the new street and park plan. In order to show that it rests upon sound principles, I preface it with a reference to the economic basis of such financing.

Can Tokyo afford to have the street and park plan necessary to assure safety to life and property in the future ? How can the cost of such a plan be met ?

Let us assume that the cost of the new street and park plan will be not less than Y.200,000,000. The value of the land to be taken for public purposes will be fixed by a commission of three men on the basis of values *after*, not *before* the fire.

Is there a sound economic basis in Tokyo for such a huge outlay ? How can it be met ?

1. The first fact to be noted is that the great fire destroyed at least Y.2,000,000,000 worth of property in Tokyo, to say nothing of lives. That is Y.20,000,000 a year for one hundred years. It is safe to assume from past experience that within another hundred years a disaster equally great or even greater will occur if proper precautions are not now taken against the danger. If Tokyo had had on September 1, 1923, a proper street and park plan it is conservative to say that at least Y.500,000,000 worth of property could have been saved, namely, an amount equal to twice the total cost of the proposed street plan.

2. The actual financial basis of the new street and park plan, however, is the *value of land in Tokyo*. As there was no scientific, full-value assessment we do not know the value of land in Tokyo before the earthquake and fire. However, a number of careful studies were made at the Institute for Municipal Research ; estimates of land values were prepared. These estimates ran from Y.1,300,000,000 to Y.1,880,000,000. Some students were inclined to place the value at Y.2,000,000,000.

As there has been no scientific assessment system in Tokyo, there is no way of knowing the amount of the *annual increase* of land values in Tokyo.

In New York city the value of the land in 1920 was $63,000,000 more than in 1919. In the city as a whole the value of the land doubles about every fifteen years. In other American cities of the first class land values double every twenty or twenty-five years.

In San Francisco the land values sank immediately after the earthquake and fire, but they were back at normal within ten years.

Tokyo is a great capital of a great nation. It is the center of commerce, industry, and finance. It is the home of more than 3,000,000 people, if we reckon the suburbs.

There is every reason to believe that the value of land in Tokyo will return within ten years to the figure at which it stood on September 1, 1923.

There is every reason to believe that within twenty years it will double. The rate of increase will itself increase. It is safe to estimate the value of land in Tokyo in 1950 at Y.5,000,000,000. *This does not include Greater Tokyo. If that is included, the amount will be enormously increased, as the area of Greater Tokyo is seven times that of the present city.*

The value of Tokyo land will increase more rapidly if provisions are made for safety to life and property. Otherwise industry and business will move elsewhere and land values may suffer.

Now the value of land is a measure of the economic power of the community, of its ability to pay for necessary public improvements.

It is safe to say, therefore, that within a period of 27 years the increase in the value of land in present Tokyo will be ten times the total cost of the street and park plan.

It is in insurance against disaster and in the increase of land values that we must find the economic basis for meeting the cost of the new street and park plan.

Definite Scheme for Financing Street Plan.

1. Purchase of land for streets and parks.

Y.200,000,000 to be paid for land taken.

Y.66,666,666 to be paid from Imperial Treasury on basis of principles set forth above.

Y.66,666,666 to be paid by the city of Tokyo as a whole.

Y.66,666,666 to be paid by the property owners benefitted.

The landowners are to be compensated by Imperial Government certificats bearing 6 per cent. interest for the whole amount of Y.200,000,000. The Imperial Government is thus to lend to the city of Tokyo and to the property owners benefitted enough money to meet their shares of the cost, including interest charges for five years. At the end of five years the city government and the property owners benefitted shall begin to pay the interest charges on their shares and small annual installments on the principal. These amortization installments shall increase slowly but steadily in such a way as to discharge the principal within a period of fifty years.

2. Compulsory widening of congested area streets without compensation to owners of lots.

Provide that no house shall be built on a street less than two ken wide, and that every house built on a street only two ken wide shall be set back from the street at least one half a ken. By this process streets will in fact be three ken wide.

To carry out this law, a commission of three men should be created to lay out the new streets and indicate where buildings can be erected. This court should consolidate remainders of land and lots too small for building purposes and sell the same at auction. The proceeds of such sales should be distributed among former owners on the basis of their old holdings.

This shall be done without any compensation to landlords in the name of public safety and public health.

Even in America, where private property is surrounded with close safeguards, the use of land for building purposes is strictly regulated in the interest of health and safety, and courts have declared such legislation is not confiscatory, but merely regulative.

By legislation of this character the old slums of Tokyo could be wiped out without spending one yen. This alone would be a revolution in the street plan of Tokyo.

3. Financing of public improvements other than streets.

Delay as long as possible all improvements which do not produce revenue.

Issue bonds for revenue-producing utilities. Make such bonds a first charge on the revenues of the utilities and back them by the guarantee of the Imperial Government. If necessary the Imperial Government should take over and manage the utilities until the bonds are paid off from earnings.

Make sewers revenue-producing by putting a charge on the people who use them. The cost of removing night soil is now great, and no doubt the sewers could be made to produce large revenues.

XI. Considerations of Prestige and Aesthetics

On this subject I have already submitted to you a memorandum, but I cannot conclude without referring to it once more. The drama of history is shifting from the Atlantic Ocean to the Pacific. Japan will play a great rôle in that drama, and Tokyo will be the seat of many impressive scenes. It is of the highest significancc, therefore, that the capital of Japan should have distinction. A mean capital will lower the prestige and dignity of the nation in the councils of the Powers.

Now that distinction cannot be achieved by reproducing here the architecture of third-rate provincial American cities. Already there are too many Western monstrosities in Tokyo. The capital of Japan will have distinction only by expressing the artistic genius of the nation. Having seen with my own eyes the glories of the past, I shrink with dread from the thought that the spirit of the ancient beauty may be trampled to earth in the period of reconstruction. I know that the practical requirements of commercial and industrial architecture are incompatible with some aspects of the old architecture. I do not insist upon the impossible, but I do venture to make the following recommendations: (1) that if possible a touch of Japanese style be given to all public buildings; (2) that western monuments of stone and bronze in western style be ruthlessly discarded in favor of monuments in pure Japanese style; and (3) that all parks and public gardens be done in pure Japanese style.

Many leading American cities have established art commissions to pass upon the designs of all public monuments and buildings. These commissions have been highly successful in elevating public taste. They have made many mistakes, for their members are mortal, but they have awakened public interest in æthetics and they have prevented the erection of thousands of architectural monstrosities. I therefore renew my earlier recommendation that a permanent art commission be appointed for the capital. To allay the fears of hard-minded practical men, I may add that beauty and distinction in Tokyo will "pay," for they will draw thousands of tourists from all quarters of the world. No one will want to visit Tokyo if it is a mere reproduction of a modern American or European commercial town. When the Japanese spirit has fully recovered from the disaster the Japanese themselves will be ashamed if great efforts are not now made to provide for beauty and distinction in their national capital.

In conclusion I take pleasure in presenting to the Japanese Government through your good offices a collection of books, papers, maps, and documents placed in my hands for transmission by the Plan of New York and Its Environs, the National Institute for Public Administration (Bureau of Municipal Research), and the American Water Works Association.

Biggest Dam in Japan

PRELIMINARY work has been started on the Otaki Dam on the Kiso river, Japan, which will be the biggest dam in Japan and will be one of the highest dams in the world,. The dam being built for the Daido Electric Power Co., and will be two and one-half times the size of the Kiso No. 6 dam completed last December out of the proceeds of the $15,000,000 Daido bond issue which was offered in the United States by a banking syndicate early last summer, headed by Dillon, Read & Co.

The new Otaki dam, which will be at the headwaters of the Kiso river, will be 300 ft. in height, will contain 375,000 cubic yards of concrete and will have a storage capacity of 73,500 acre-feet. Location of this new gigantic dam at the head of the Kiso River, on which the Daido Co. already has 8 other hydro-electric developments now in operation with a total capacity of 154,800 k.w., will greatly increase the water supply available for all other plants on the river.

It is expected that the annual output of the entire group of Kiso river plants will thereby be increased by 30 per cent. Work has also begun on two other plants on the Kiso river. Thus, upon completion of these plants, the Daido Co. will have 11 hydro-electric developments on the Kiso river. This section of the Kiso is about equi-distant between Tokyo and Yokohama to the north, and Osaka to the south. Nagoya lies near the mouth of the Kiso.

The company now has contracts in hand for sale of power, which call for delivery of approximately the following kilowatt hours in the future:

Year ended November 30, 1925, 1,101,300,000 k.w.; 1926, 1,377,100,000 k.w.; 1927, 1,589,100,000 k.w.; 1928, 1,716,200,000 k.w.; 1929, 1,821,800,000 k.w.

To meet the demands of the Tokyo districts the Daido Co. has recently made new contracts with the Tokyo Electric Co. to increase its supply to that company to 50,000 k.w. by November 1926. Daido has also just received a franchise to build a 154,000 volt transmission line to sell industrial power to Tokyo and Yokohama.

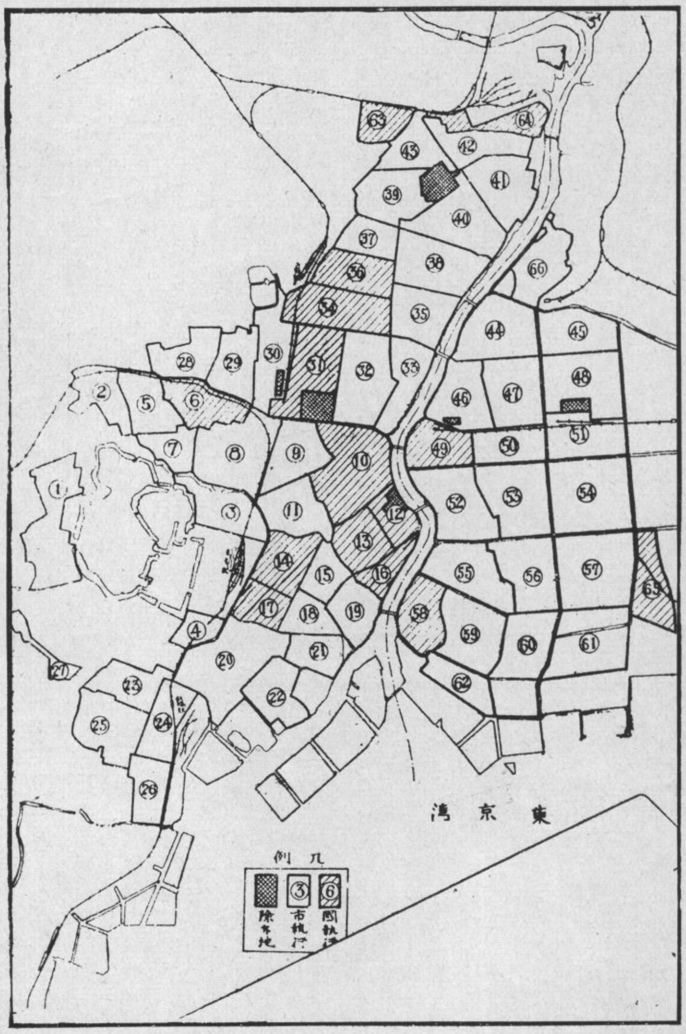
Replotting a Great City

A Drastic and Sweeping Readjustment of Land Values, on which the Whole Reconstruction Scheme of Tokyo is Based

PROUD as its position was before the earthquake, Tokyo, the fourth city of the world, was little more than an over-grown village in which magnificent stone office and bank buildings stood side by side with insignificant wooden shops, fronting on smelly tidewater creeks or canals, or streets too narrow for two Fords to pass in. The wooden buildings of bamboo and mud walls were as highly inflammable as paper, and helped to destroy their modern neighbors in the fire, while the alleyways which served as roads in the most populous down-town districts helped to roll up the hideous toll of deaths of those who could not escape from obstructed streets to places of safety.

Time after time since the Tokugawa's made it their capital, Tokyo has burnt to the ground and built up again. In the twelve years before the great fire, two disastrous fires wiped out Kanda and Asakusa, both important business quarters. Yet with these examples of the dangers of allowing wooden buildings in business districts, and the inconveniences of narrow streets ever before them, the authorities were unable to reform the building laws, or to untangle the confusion of narrow roads in the down town districts. Superficially, Tokyo was rapidly being modernized during the past fifteen years, attested to by the many beautiful modern office buildings in all parts of the city, the tramways, automobiles and other improvements. The streets and canals, however, remained the same, except in some of the residential districts where street improvements were being carried out on an entirely inadequate Municipal appropriation. In 1922, certain important business centres, notably Marunouchi in Kojimachi Ward, and Kanda Ward, were selected as the nuclei of several fireproof districts, but before the earthquake only a few buildings had been erected under the regulations then issued.

One thing was clear, the task of making Tokyo a modern city worthy of being the capital of the nation, was hopelessly beyond the existing powers of the municipal authorities. The assistance of the national government was essential to effect any reforms of administration and obtain the necessary loans to finance the improvements. This was difficult. Land in Nihonbashi and Kyobashi Wards was valued at the excessive price of 30 to 40 yen a square foot, far too expensive for the Municipality to contemplate any extensive road building program compatible with the needs of these important business districts. On the other hand, landowners were most reluctant to decrease the size of their properties, especially when buildings had to be altered to make room for roads.



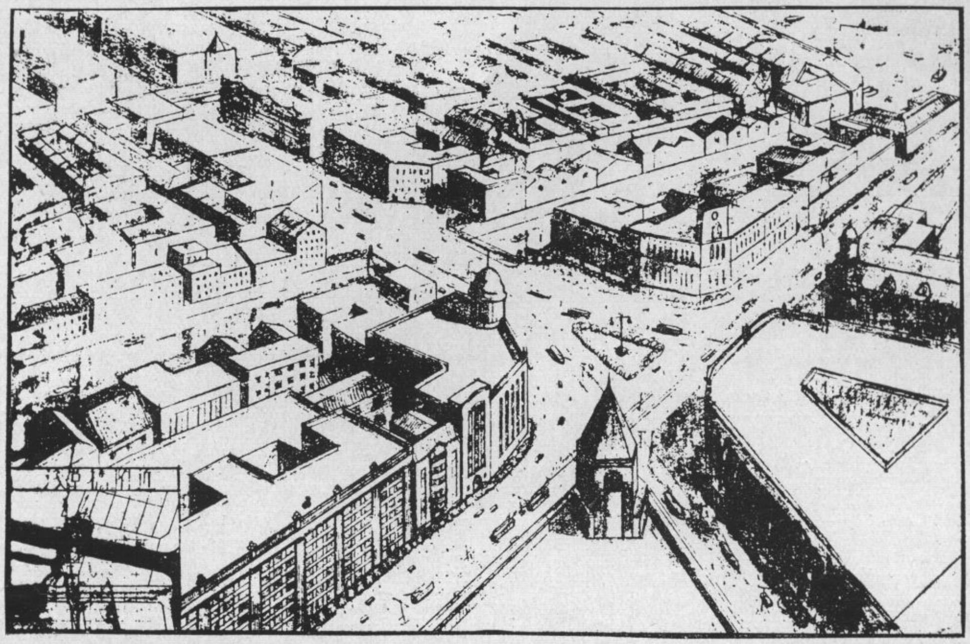
The burned area of Tokyo has been divided in 69 Replotting Districts as shown in the Map to make room for New Streets, Parks and Other Public Improvements. This Work must be finished before the new program can be carried out and permanent building construction Undertaken

The modernization of Tokyo before the earthquake had reached a stage where neither the municipality nor the citizens could move to alter the situation without the aid of the national government.

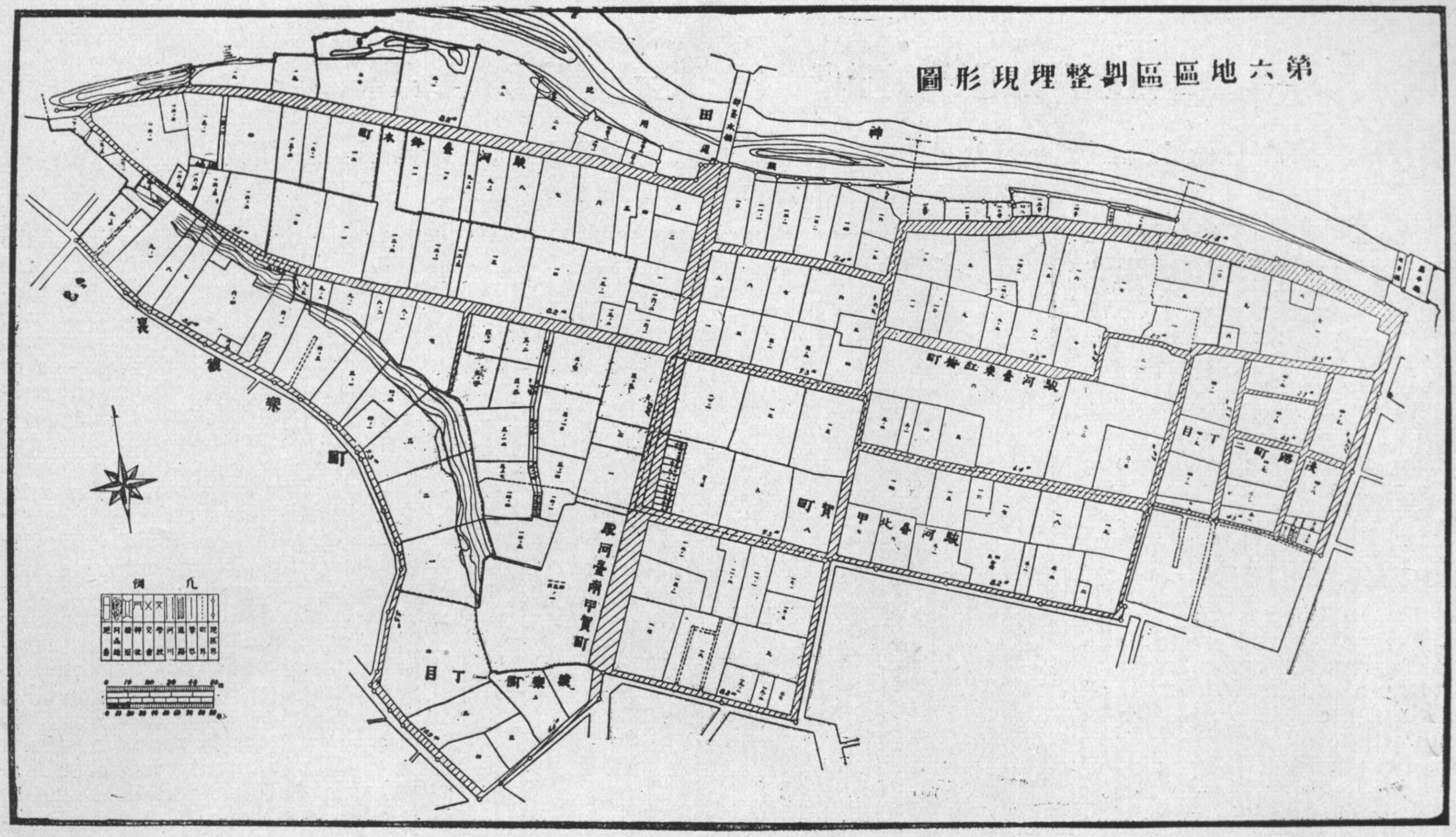
At the end of 1924, before any readjustment of land-plots had been carried out, there were about 570 miles of streets in Tokyo. Of this total, 45 miles were 72-ft. or more wide; 67.5 miles, 48 to 72-ft. wide; 57.5 miles, 36 to 48-ft. wide; 70 miles, 24 to 36-ft. wide; 110 miles, 18 to 24-ft. wide; 130 miles, 12 to 18-ft. wide, and 87 miles were less than 12-ft. wide. More than half the total, or 327 miles, were less than 18-ft. wide. Automobiles are not allowed to use streets less than 15-ft. wide. More than half the city was so badly laid out that any attempt to better conditions became a problem of the greatest magnitude.

Then the earthquake and fire destroyed half the city, and the opportunity for reform which decades of legislation could not have effected without prohibitive cost, was ready to be siezed by far-sighted, public-spirited officials and financiers.

Reconstruction, not rebuilding, was the principle on which they based their plans for the new Tokyo that was to rise from the penitential ashes of the old. No longer was the capital to suffer from periodic conflagrations



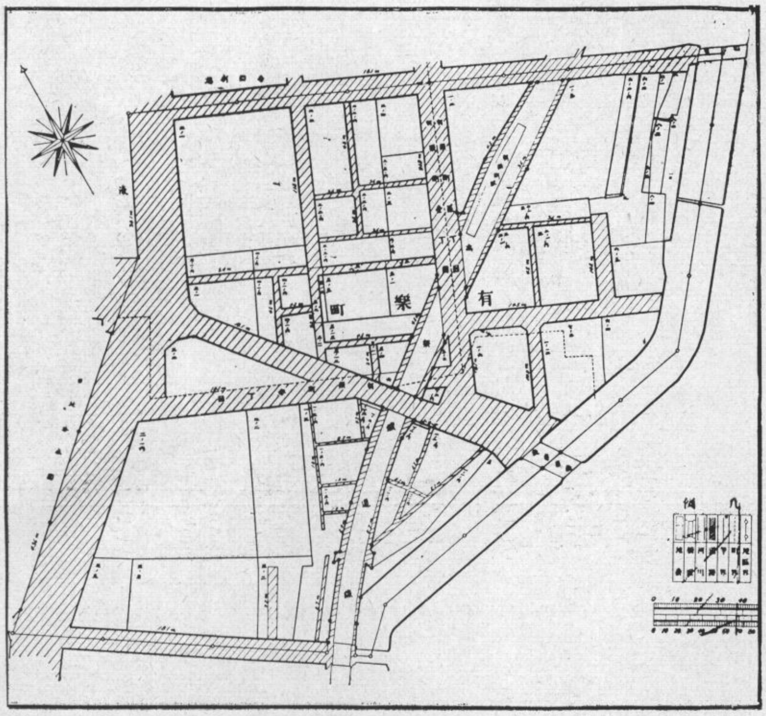
A Suggestion as to the Future Appearance of one of Tokyo's Districts after the Streets are Widened and Permanent Buildings Erected.

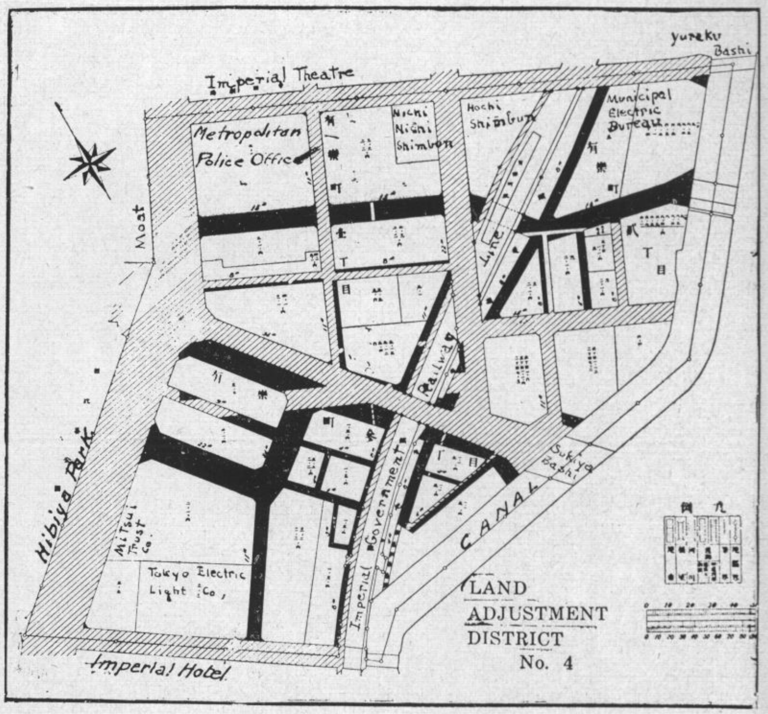


Showing Land Readjustment and Replotting in District No. 6, before and after, Heavy Black Lines Indicate New Streets and Widening of Old Ones. This Map also shows how the New Primary Schools are being erected next to Small Parks

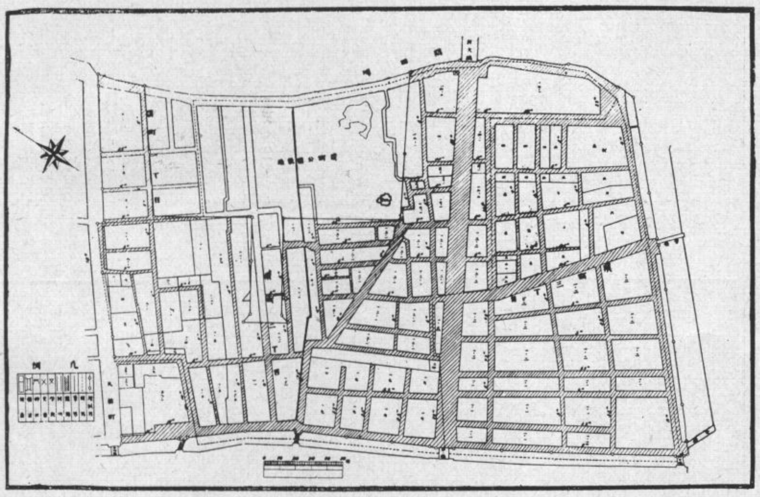
which cause endless misery and confusion. The new city should be fire-proof, at least it was planned that its most important districts would never again be laid waste by fires originating in other quarters.

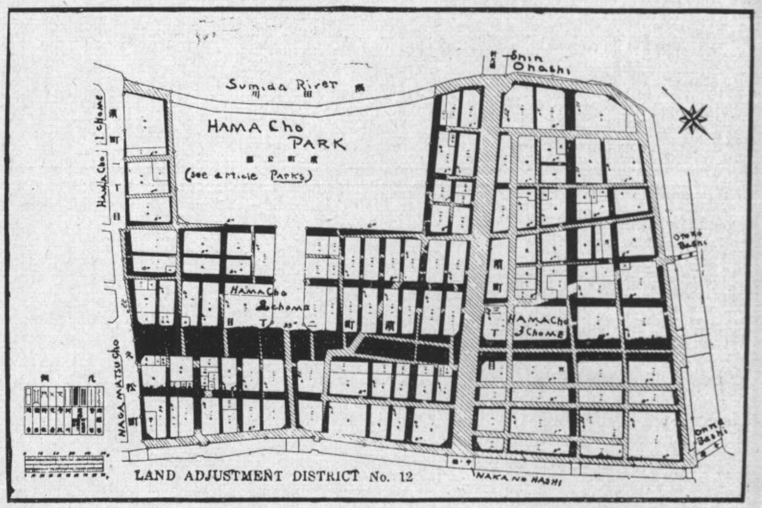
It was not many days after the fire, before property owners began to clear away the debris from their land and to knock together some sort of a temporary structure for their families and business. An Imperial Edict was then promulgated to stop *re-building* by prohibiting the construction of permanent structures in the burned district until the plans for *reconstruction* could be worked out. In December, 1923, under the title of the City Planning Law, another Edict was promulgated which determined the fundamental law of reconstruction, and in March, 1924, the Special Town Planning Committee's plans for reconstruction in Tokyo and Yokohama were approved by the Cabinet. These plans are based on the German, (Mayor Addicks system) of town building.



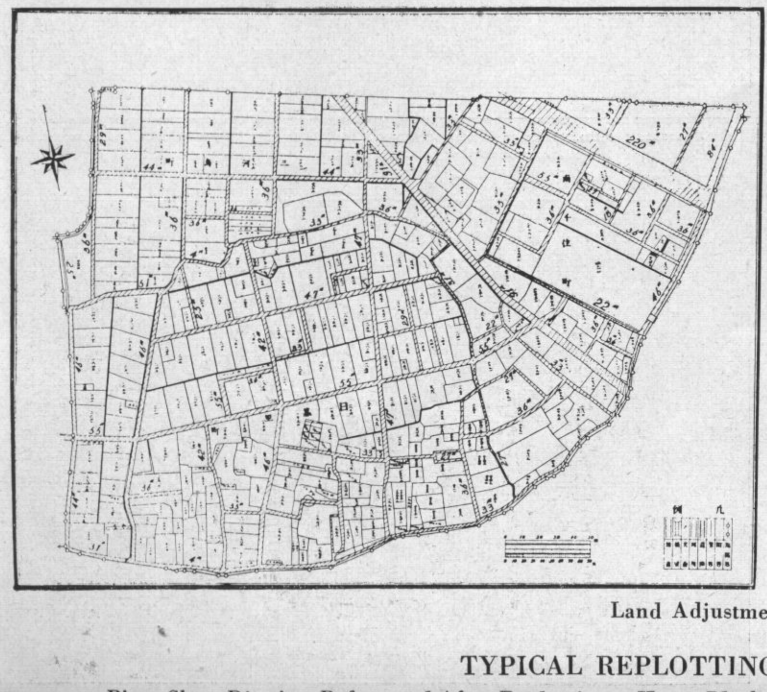


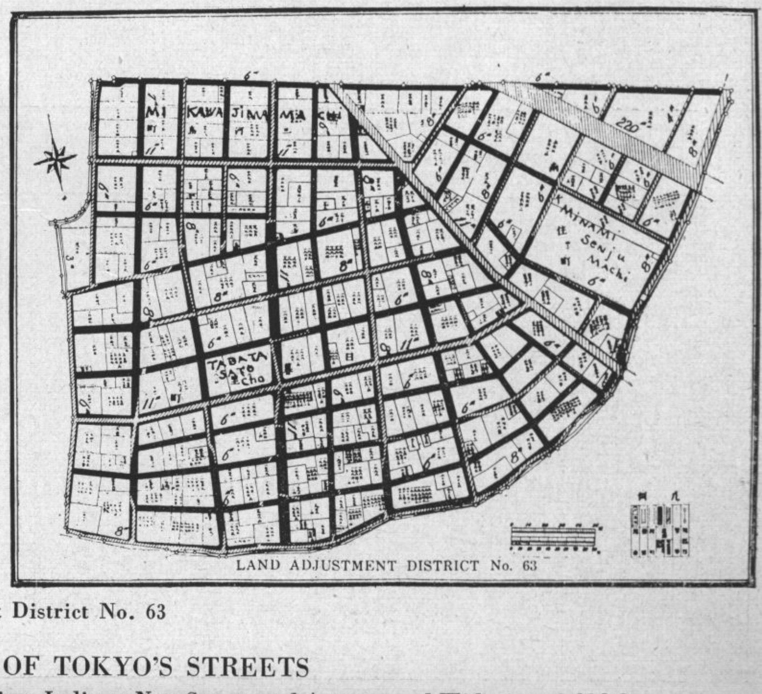
Land Adjustment District No. 4: Before and After Replotting





Land Adjustment District No. 12

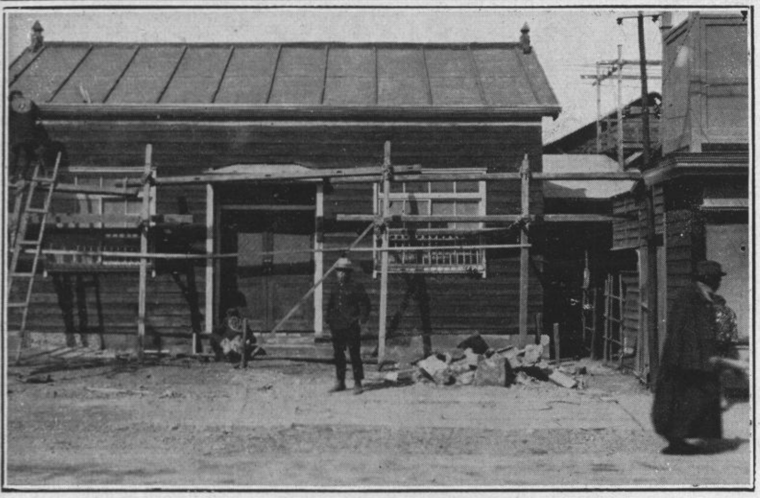


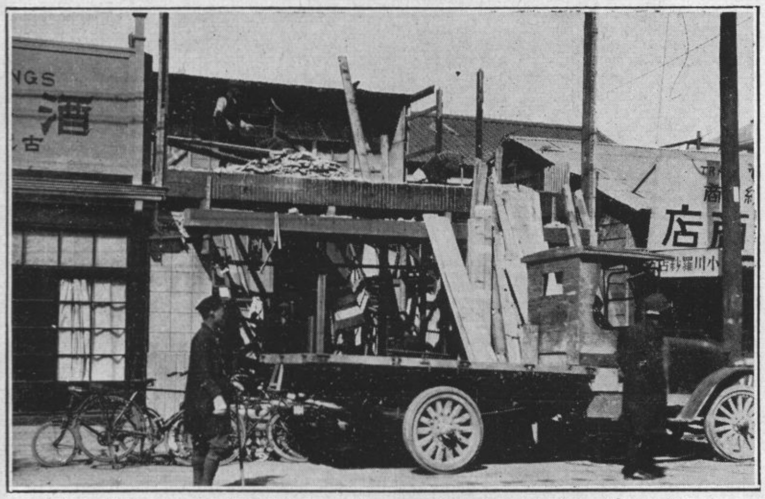


Land Adjustment District No. 63

TYPICAL REPLOTTING OF TOKYO'S STREETS

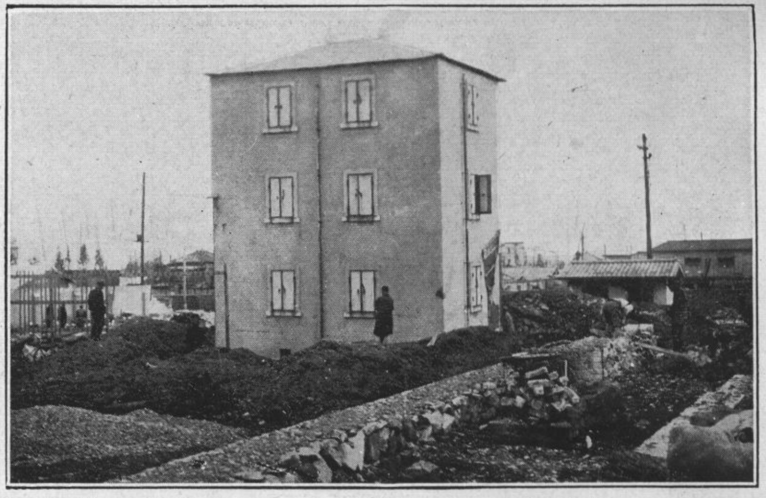
Plans Show Districts Before and After Replotting. Heavy Black Lines Indicate New Streets and Avenues and Widening of Old Ones

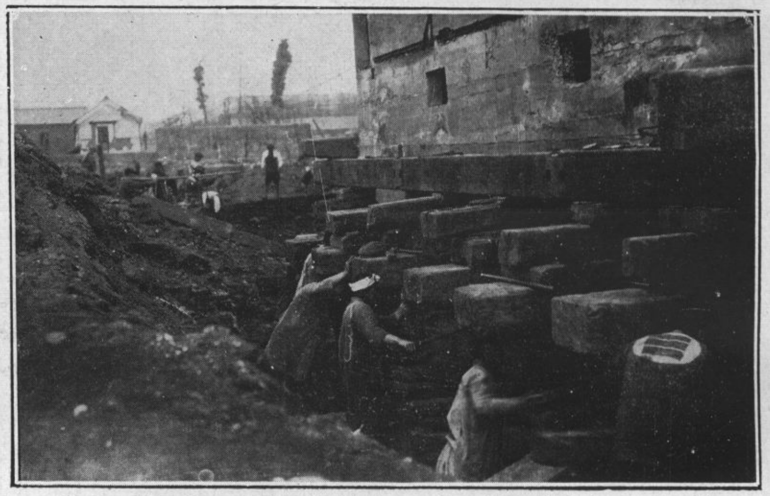




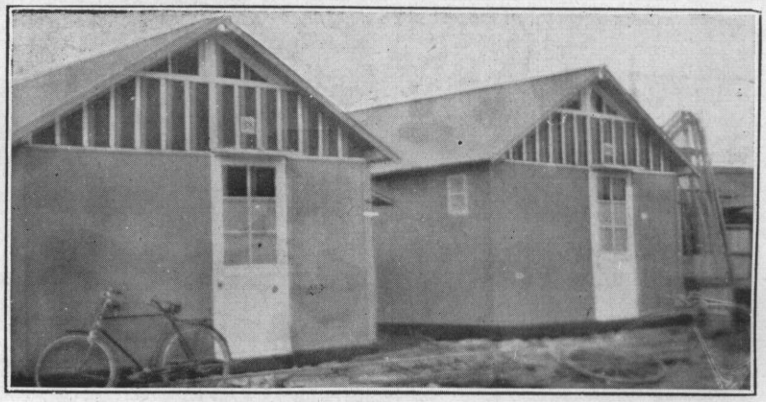
Typical Street in 6th District under Process of Replotting: Top, shows Street before Realignment. Centre shows light Wooden corner Building moved back, Bottom shows the demolition of the three storied Stucco front building which could not be moved

Main Street in 6th District to be widened to 22 meters and paved. The Radio Shop shows how easily Some People are able to meet Readjustment problems



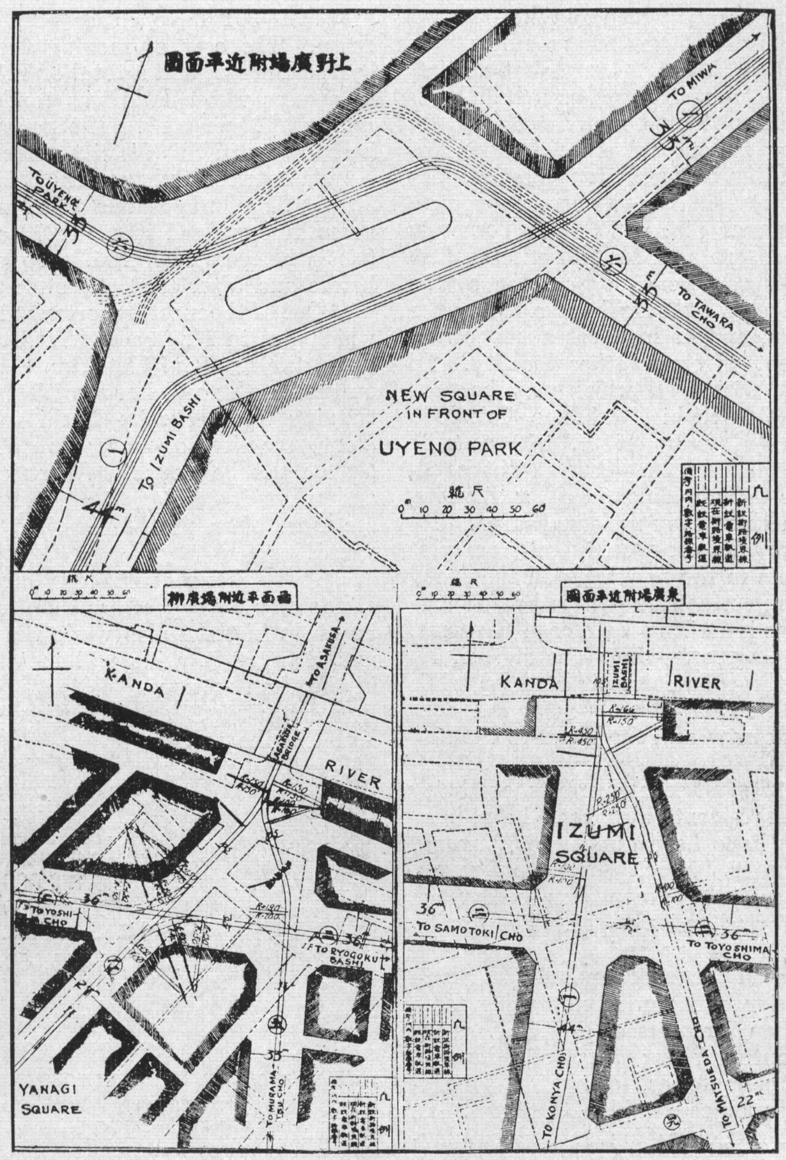


Moving a Storehouse in the 6th District to New Site. This Structure withstood the Quake and Fire



American Knock Down House Costing Y600, Erected by the Reconstruction Bureau as temporary Barracks in 6th District

Type of Shop Building moved in 6th District to make Room for Street Widening



Laying Out New Squares for Tokyo; Top shows Outline of the New Plaza in front of Uyeno Park, Below two New Squares in Kanda-ku. The Old Streets and Building lots are shown by dotted lines, the New Squares and Street alignment are the Shaded Lines

Nishi Horidome Canal; Filled in and the Reclaimed Land used for Compensating Owners whose Properties have been Condemned in other Sections

The Reconstruction plans provide for radical changes in drainage and sewer systems, water supply, tramway system, sub-surface structures, roads and land plotting. The sums required for complete changes are so enormous that it is questioned if they can ever be carried out. The appropriations to cover the period 1923-1929, however, are based on investigations made by the financial leaders of the nation who have ascertained definitely the burden the people can carry in order to rehabilitate the capital city. The authorities are determined that nothing shall stand in the way of making Tokyo one of the finest cities in the world, and the work to be accomplished before the end of 1929 by no means represents the total which undismayed determination will eventually achieve. Plans are already being drawn which will extend the town building work in Tokyo to 1945.

The most urgent work in Tokyo is the construction of a new street system which will straighten out the rambling alleyways, be wide enough for automobile traffic and afford space ample to stop the spread of fires. To do this, all roads now less than 18-ft. wide in the city limits should be eliminated. The law provides that one-tenth of any plot of land required for road work may be condemned for public use without compensation to the owners. This was a revolutionary measure for Japan and not without its opponents amongst the property owners, but as the value of their holdings will eventually increase and cover these losses, it has not been difficult to persuade them to conform to the provisions of the law.

The Road Section of the reconstruction bureau has prepared a map for its guidance showing every house in Tokyo and the location of all gas, sewer, and water mains, high tension wiring, canals, roads, etc. The name of every land owner and lessor of land is separately registered, together with information as to the value of their holdings and details concerning the rights of occupancy acquired by owners before the fire. These rights of occupancy are the great stumbling block in the way of a speedy adjustment of land districts. They are based on a legal fiction not supported by law but by custom, that a person who occupied land and carried on business or had his dwelling on it before the earthquake, should not be deprived of the opportunity to use that site again because of reverses forced on him by the disaster. Such rights are tenaciously maintained even though the land has not been occupied since the earthquake, and there is no intention or ability of ever doing so again.

To construct the new main arteries of traffic in Tokyo some 680,000 *tsubo* of land are needed. Most of this is land on which rights have accrued. For the narrower streets another 620,000 *tsubo* is required, a total of 1,300,000 *tsubo*; in addition to such land as is required for parks and canal construction.

Some idea of the magnitude of the task confronting the Reconstruction Bureau can be understood from the fact that 680,000 *tsubo* means, in the burned districts, land on which 150,000 people lived. The total of 1,300,000 *tsubo* therefore displaces 300,000 people, who must find other homes. In some of the burned districts more than 50,000 *tsubo* must be purchased, and with land at Y. 1,000 a *tsubo* before the earthquake, this means financial difficulties.

The burned area has been divided into 66 so-called Land Adjustment districts in which great changes in the size and form of lots must be carried out to conform to the new road building plans. The national government will bear the full costs of adjusting properties in fifteen districts, and the reconstruction bureau will carry out the work in the other 51 districts. The national government will grant a subsidy up to two-thirds of the costs, and lend the balance on long term loans and low interest charges to the city, which will assume the responsibity of carrying out the program.

Surveys of all districts have been completed, and in sixteen, the negotiations with landowners, lessors, and "right" holders are finished. The surveys revealed many strange conditions of ownership which were difficult to

adjust. To assist the authorities in a task which at times seemed hopeless, a committee composed of 16 to 20 members was organized by law in each district, half being government officials (the reconstruction bureau and the municipality), and half land-owners, lessors and "right" holders. These committees first fix the land values, then trace the new streets and proceed to re-plot the entire district. Owners of land, in so far as it is possible, are assured of locations in the new plots similar to those they own. That is to say, the owner of a corner plot will have a corner in the corresponding new plot, and so on. All land in excess of 10 per cent. condemned for street improvement, is paid for at the values determined by the committee. It often happens that the readjustment wipes out entire lots, and in such cases the owner is compensated with a similar lot in some other locality. To provide the reconstruction bureau with land which may be used for this exchange of property, the Nishi Horidome Canal in Nihonbashi Ward where land has a value of Y.1,000 a *tsubo* (about 28 yen a sq. ft.), has been filled in. Owners not satisfied with compensation offered for their holdings in other districts, may be required to accept lots in this newly reclaimed area.

Lessors and "rights" holders who are transferred from plot to plot, are granted the same rights in the new location that they held in the old, and in case it has not the same value because the locality is not so desirable the loss is made up by a cash payment. Often tenants and owners can not agree on the value of their respective rights and the work of the committees is held up while they haggle over details. In such cases it has been found convenient to transfer both the landowner and the lessor to the new location and let them fight it out.

In connection with Land Adjustment scheme efforts, are being made to zone the city into distinct residential, industrial and business districts and although plans have been adopted it is feared that many difficulties will be encountered in carrying them through.

Besides Tokyo, the reconstruction bureau has under its jurisdiction eighty other cities, towns and villages. The zoning system is to be applied to Tokyo, Yokohama and 36 of these other villages and towns. In residential districts, no licenses will be granted in future for construction of factories employing more than 15 persons, or using more than 2 motors or any boilers; for garages housing more than 5 automobiles; theatres, cinemas, and other amusement places; crematories, slaughter houses, garbage disposal places, or other objectionable structures. In business districts, buildings which obstruct traffic; factories employing more than 50 persons, or using more than 10 motors; garbage disposal places; and other objectionable structures will not be permitted. In industrial districts, establishments manufacturing articles detrimental to the health of the community will not be permitted; these are to be located in a special district well outside the city. Along the banks of the Sumida River at its mouth, a special warehouse district is to be created.

The residence districts cover the high lands in the north part of the city, from Uyeno to Asukayama, Oji, and in the south part from Meguro to Takanawa. The business district covers practically all Asakusa, Shitaya, Kanda, Nihonbashi, Kyobashi, Kojimachi, and half of Shiba Wards. In the residential and business zones, along both sides of all main roads, special business districts may be built. The industrial zones are located east of the Sumida River extending to the Arakawa, and south of Shinagawa to Osaki (on the way to Yokohama), and in other parts of the city where the bay or canals are convenient for transportation.

In the business zones, notably in Kojimachi Ward (where Marunouchi is fast becoming the business centre of the city), and in Kanda, fire-proof districts are to be constructed. From the new Diet buildings in Nagata Cho in Kojimachi Ku, to the Ginza, and along that street to Iwamura Cho in Kyobashi Ku, and inside this line to the Inner Moat around the Palace, the entire district is limited to fire-proof and earthquake proof buildings. In the other parts of Kanda, Kojimachi, Kyobasji, Honho, Fukagawa, Asakusa and Shitaya, fire-proof buildings must be built within 90-ft. from main streets. It is expected that these measures will make it possible to build up new Tokyo so that fires will no longer be able to spread from district to district without a chance to stop them at wide streets.

Actual work of moving houses to make way for street construction has been commenced in Districts 4-6-12-16-42-49 and 64. In the sixth district more than 444 houses have been removed, of which 301 have either been completely moved away or torn down. The cost of moving these houses, Y.348,000, was borne by the Bureau, and a total of Y.189,400 was paid in compensation to owners whose land was condemned in excess of the statutory limit of 10 per cent. The actual area of land which the Bureau had to buy in this district, which is largely in the back streets of Kanda between Ochanomizu Bridge and the main car line between Jinbo Cho and Oshima Cho, was 947 *tsubo,* which the district committee valued it at Y.200 a *tsubo.* Street work in this district will cost Y.575,735. A glance at the maps of this district before and after land adjustment will show what has been done.

One of the most important districts to be adjusted is the fourth, which lies in Kojimachi Ward, near Hibiya Park, covering land up to the Imperial Hotel, on the South, and the Imperial Theatre on the North; and East to West from the Outer Moat to the Canal running from Yuraku Bashi to Sukiya Bashi. In this district alone, the sites of more than 500 houses are affected, and 4,500 *tsubo* must be bought. Work on this district has been started and when it completed this quarter of the city, which tourists see more often than any other, be as modern as any city in the world.

These changes in Tokyo have not yet been applied to sections of the city untouched by the fire. In time, however changes will be made in them also while the decision not to build more roads less than 18-ft. wide will materially better land plot conditions in the then sections.

The Budget appropriations for Land Adjustment in Tokyo and Yokohama are:

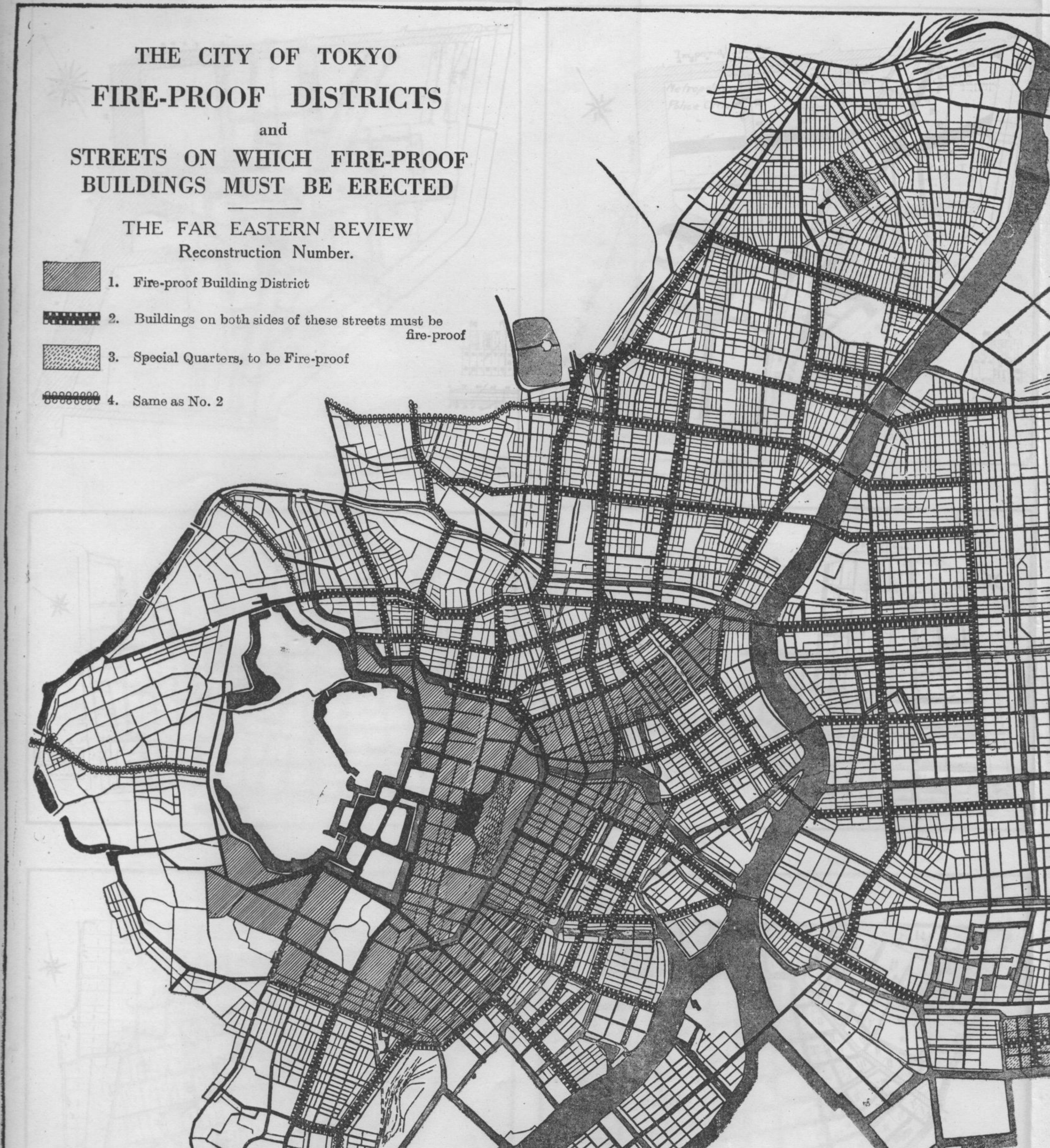
	For construction in districts under jurisdiction of National Government	Ditto Municipal Jurisdiction Subsidy, 2/3rds of costs	Loan from National Government
Tokyo	Y.8,750,000	Y.22,634,000	Y.11,317,000
Yokohama ...	2,561,000	2,786,000	1,393,000
Total ...	Y.11,311,000	Y.25,420,000	Y.12,710,000

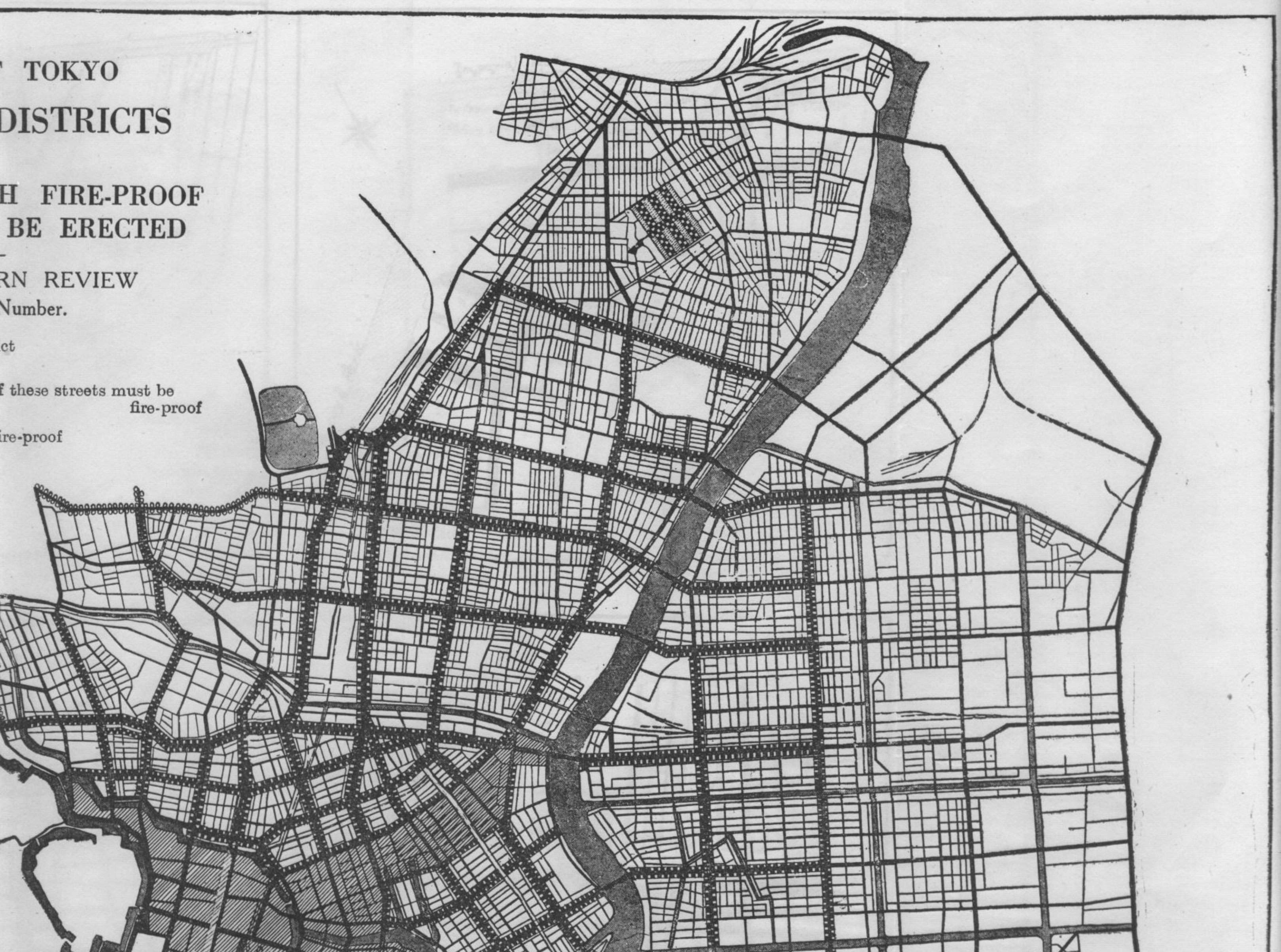
The total expenditure authorized in Tokyo is Y.49,441,000; in Yokohama, Y.6,740,000; making the grand total for adjustment of land plots, Y.49,441,000. Besides this about Y.80,000,000 will be spent in building roads which are necessitated by the land adjustment programs in the two cities.

In Yokohama, the land adjustment work will extend over 12 districts, five of which will be under the jurisdiction of the reconstruction bureau, and seven under that of the Municipality. Landowners who must submit to a slicing up of their plots will be compensated by permission to remove to properties of persons killed in the earthquake and fire whose heirs have not yet claimed possession.

The zoning system and the fire-proof district plans also apply to Yokohama, but the details have not yet been satisfactorily worked out.

Springfield Road Roller, used in Street Construction Work in Tokyo


THE CITY OF TOKYO
FIRE-PROOF DISTRICTS
and
STREETS ON WHICH FIRE-PROOF BUILDINGS MUST BE ERECTED
THE FAR EASTERN REVIEW
Reconstruction Number.
1. Fire-proof Building District
2. Buildings on both sides of these streets must be fire-proof
3. Special Quarters, to be Fire-proof
4. Same as No. 2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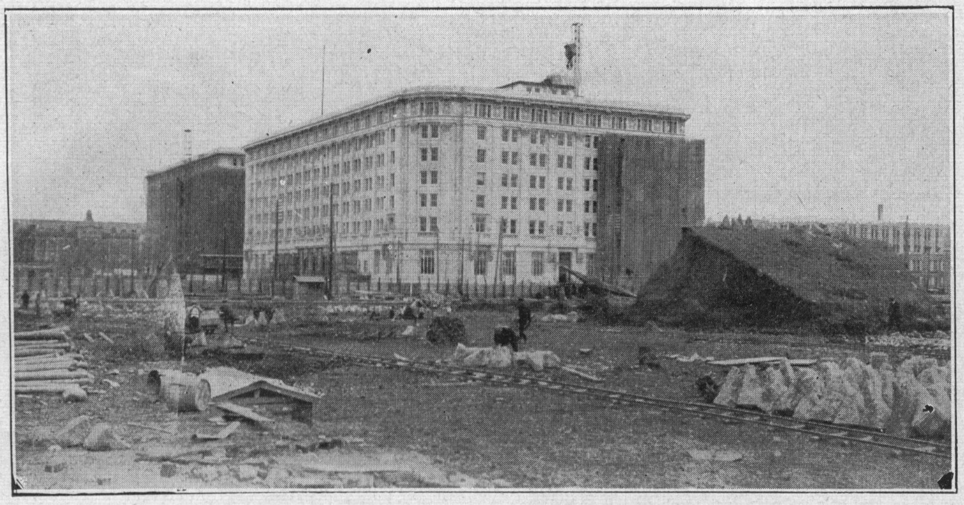
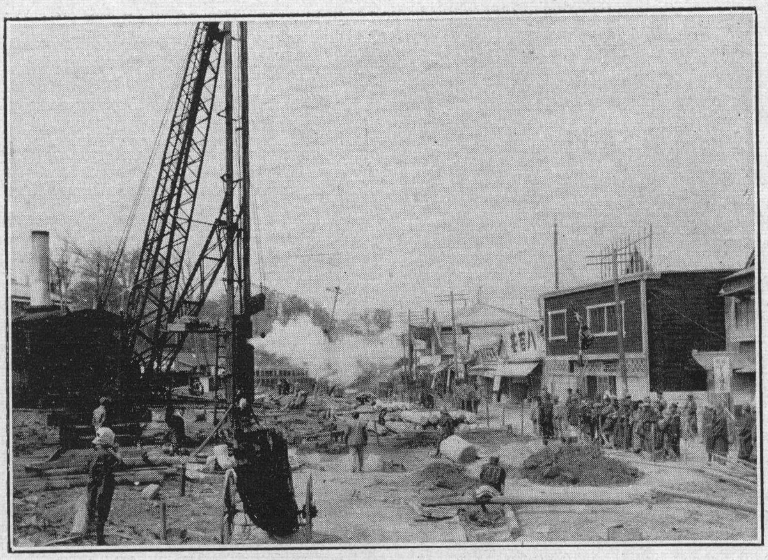
Street Scheme for the New Metropolis

A Splendid System of New Thoroughfares, Avenues and Cross Streets Will Replace the Narrow Winding Alleyways of the Old City



New Avenue leading from Palace Grounds to Tokyo Central Station Created by Filling in Moat

THE advent of the automobile in Japan, and especially its increasing use within the larger cities, is more and more displaying the inadequacy of the present crushed stone and gravel roads to accommodate the rapidly increasing traffic conditions of this country, and the imperative need for permanent streets and roads. Also, the importance of providing streets sufficiently wide to stop the advance of fires, combined with the radical changes in the street system made necessary by the rebuilding of Japan's capital city and principal seaport in accordance with modern ideas, has presented a problem of considerable magnitude. Japan, however, is fully awake to the vital necessity for making these improvements, and one of the most noticeable indications to-day of progress in the carrying out of the extensive reconstruction program to be undertaken during the next five years may be observed in the rebuilding and repairing of the main traffic arteries located within the devastated area.



One of the Many Street Building Scenes in Tokyo: Uyeno Park

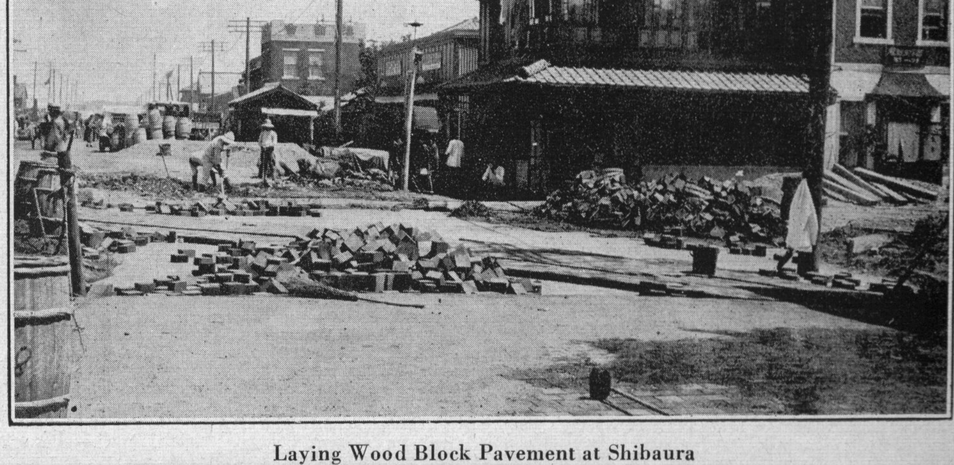
The present road building program to be undertaken within the cities of Tokyo and Yokohama provides that the work of improving roads 22 metres and above in width will be done by the National Government, while roads between 11 and 22 metres will be rebuilt by the respective Municipal Road Bureaux having jurisdiction over this class of work within the cities in which the improvements are to be made. In addition, the Electric Bureau will construct five roads within the Tokyo district in connection with the program for the extension of the present surface car system operated by that bureau.

In July 1923 there were 2,780,000 *tsubo* of roads in Tokyo, or 11.6 per cent., as compared with the total area of the city, amounting to 23,970,000 *tsubo*. The proposed road Building program approved by the Reconstruction Bureau will, upon completion, bring this percentage up to 26, which, compared with that of the principal cities of the world, is as follows: Paris 25; Berlin 26; Philadelphia 29; Vienna and New York 35; and Washington 40.

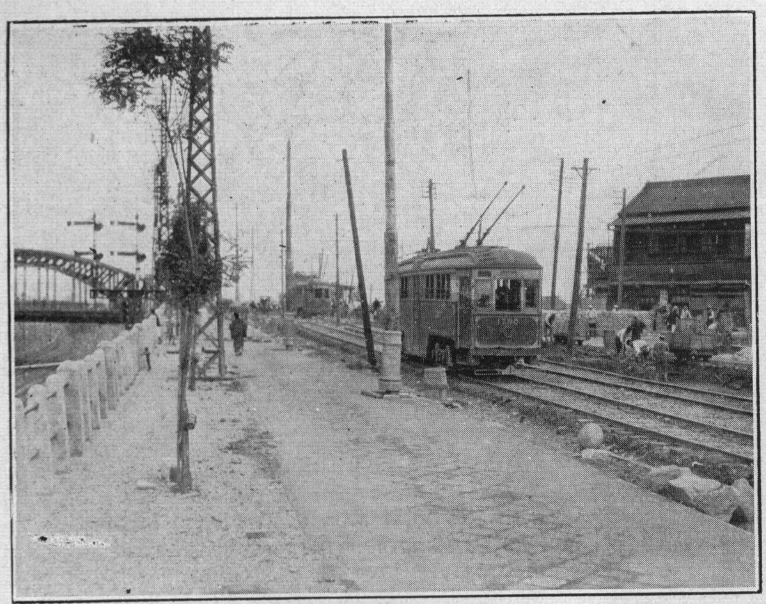
The total road building program for the city of Tokyo alone consists of a combined length of new roads amounting to 505,373 metres and comprises an area of 2,595,000 *tsubo*. Details of this road construction program are as follows:

	Length *Metres*	Area *Tsubo*
Main Avenues: To be built by the National Government ...	118,534	973,000
Secondary Roads: To be built by the Municipality	138,621	534,000
Secondary Roads: To be built as part of the Land Adjustment scheme (both by the National Government and the Municipality)	248,218	1,088,000
Total ...	505,373	2,595,000

The following schedule outlines the extent of the work to be undertaken by the Reconstruction Bureau in providing Tokyo with new streets and roads, and indicates as well the progress made up to December 31, 1924.



Laying Wood Block Pavement at Shibaura



ROAD BUILDING IN TOKYO

At Shinagawa, where the National Tokaido Highway Commences

Road Foundation Work, Shibaura

Road Number	Location	Width *Metres*	Length *Metres*	Percentage of Work Completed
1.	Shinagawa to Honshiba, 1 chome, Kobiki Cho, Edobashi, Iizumi Bashi, Kurumazaka and on to the line of the Joban Railway, Senju	22-44	13,596	—
2.	Kudan Zaka Shita to Minami Jonbo Cho, Ryogoku Bashi, crossing Sumida River to Kameido	27-36	6,200	—
3.	Gofukubashi to Eitai Bashi and Sawaumi Bashi Sunamachi	33	5,255	—
4.	Muraku Cho, 1 chome, to Owaricho, Kobiki Cho, 3 chome, Tsukiji 3 chome, Tsukishima, thence cross Sumida River, which latter construction will be a separate undertaking	27-36	2,270	—
5.	Tsukiji 3 chome to Irifune Cho, Kamejima Cho, Hama Cho 3 chome, Asakusa Bashi, Minami Moto Machi, Kita Tawara Machi and Kanasugi Shita Machi...	33	8,048	10%
6.	From the front of Uyeno Park to Komagata Machi, Oshiage	33	3,640	5%
7.	From the East of Tokyo Station to Shimomaki Cho, and Kamejima Bashi, Echizenbori, 1 chome	22-44	1,110	—
8.	Eiraku Cho, 1 chome, to the Vicinity of the Moat at Moto Chiyoda Cho	73	200	100%
9.	Sakurada Mon to the front of the Diet Buildings	55	580	—
10.	Aioi Bashi, south to Wakura Cho, Aioi Cho and Nakanogo Take Cho	25-33	5,050	—
11.	North side of Tokyo Station to Zenigame Cho and Shin Tokiwa Bashi, Kodenma Cho, 1 chome, and to Asakusa Bashi ...	27	1,580	—
12.	Kanda Bashi to Ogawa Machi, Yushima 4 chome, Hongo 1 chome and Hongo 3 chome...	27-33	2,075	—
13.	Hitotsubashi, Minami Jinbo Cho to Ikidonozaka	27	1,973	—
14.	Otemachi, 1 chome, Kijibashi to Iidabashi	27-36	2,605	—
15.	Toranomon, through Nishi no Kubo to Kamiya Cho	27	970	—
16.	Sakurada Hongo Cho to Shiba Park ...	33	1,055	—
17.	Kajibashi, Yanago Machi, Danjo Bashi to Eitai Bashi	22-33	1,718	—
18.	Shibaguchi 1 chome, Toranomon to Akasaka Mitsuke...	33	2,745	—
19.	Kijibashi, Kamakura Gashi Dhirobe Gashi to Shimbashi...	22-27	4,064	—
22.	Fujimi Cho (Kojimachi) to Ichigaya Mitsuke	27	930	—
21.	Kudanzaka to Fujimi Cho, 1 chome, Hanzomon and New Diet Buildings at Nagata Cho, Kojimachi-ku	27	2,540	—
22.	Yushima 4 chome, Nicho Machi, Kuramae Katamachi, Hoonji Bashi to Kameido ...	22-27	5,480	—
23.	Asakusa Tamachi 2 chome to Kanasugi Shita machi	22	782	—
24.	Yokoami Cho, 1 chome, to Ryogoku ...	33	163	—
25.	Kobiki Cho 2 chome to Tsukiji 4 chome...	27	200	—
26.	Minami Moto Machi to Umaya Bashi, Kurofune Cho	27	363	—
27.	Fukuzumi Cho to Ogi Bashi, Sunamura ...	22	3,163	—
28.	Hamacho, 3 chome, to Nakasu Machi, Higashi Ogi Bashi and Suna Machi ...	22	3,981	—
29.	Hama Cho, 3 chome, Shigo Hashi to Tokuemon Cho, Hikugawa Bashi, Oshima Machi	22-27	3,226	—
30.	Nakanogo Motomachi to Terajima Machi...	2	1,920	—
31.	Yamanoshuku Machi to Imado Bashi ...	22	385	—
32.	Asakusa Zaimoku Cho to Yoshinobashi, Minami Senju to the line of the Joban Railway	22-25	2,655	—
33.	Otomachi 1 chome, to Shita Saya Cho, Arame Bashi, Hama Cho, 1 chome, to Ryogoku Bashi	22	2,980	—
34.	Ryukan Bashi to Konya Cho, Mikura Bashi, Take Cho, Iriya Cho	22	3,960	—
35.	Dosan Cho, Kamakura Gashi, Shohei Bashi, Tenjincho, 2 chome, to Ikenohata, Shichikencho...	22	3,500	13%
36.	Imairi Cho, Atago Cho to Akabane Bashi...	22	1,920	—
37.	Minowa Machi to Shirahige Bashi... ...	22	1,637	—
38.	Iriya Cho to Yamanosuku Machi and in front of Asakusa Station, Nakanogo and Narihira Cho...	22	2,836	—
39.	Arame Bashi to Shimbashi Koami Cho, 4 chome	22	380	—
40.	Nishi no Kubo, Kamiya Cho to Utagawa Cho	22	910	—
41.	Nishi Ogawa Machi to Misaki Cho, 3 chome and the Artillery Arsenal	22	580	—
42.	Nagata Cho, 2 chome	22	354	100%
43.	Tameike Machi to Tamachi 7 chome ...	27	180	—
44.	Ikedonozaka to Hongo 1 Chome	27	580	—
45.	Higashi Kuromon Cho to Uyeno, Hirokoji	36	145	—
46.	Suda Cho, Manseibashi	36	110	—
47.	Kiba Machi to Heikyu Cho	22	80	—
48.	Shiba Park to Hamamatsucho, 1 chome...	27	611	—
49.	Kiji Bashi to Motoshiro Cho, 2 chome, Toshima Cho...	22	1,845	—
50.	Muramachi Cho to Toshima Cho	22	573	—
51.	Yushima Tenjincho, 3 chome, to Umaya Bashi, Oshiage	22	3,877	41%
52.	Ikenohata, Naka Cho	22	300	—
53.	Etchujima Machi to Hamazono Machi ...	22	1,025	100%

The combined length of these 53 roads amounts to 118,900 metres, of which plans for 22 per cent. have been finished and surveys for 73 per cent. completed.

The following specifications approved by the Reconstruction Bureau, will govern all future road construction undertaken as a part of the general reconstruction program :

1.—The metric system will be used in designating the width of roads.

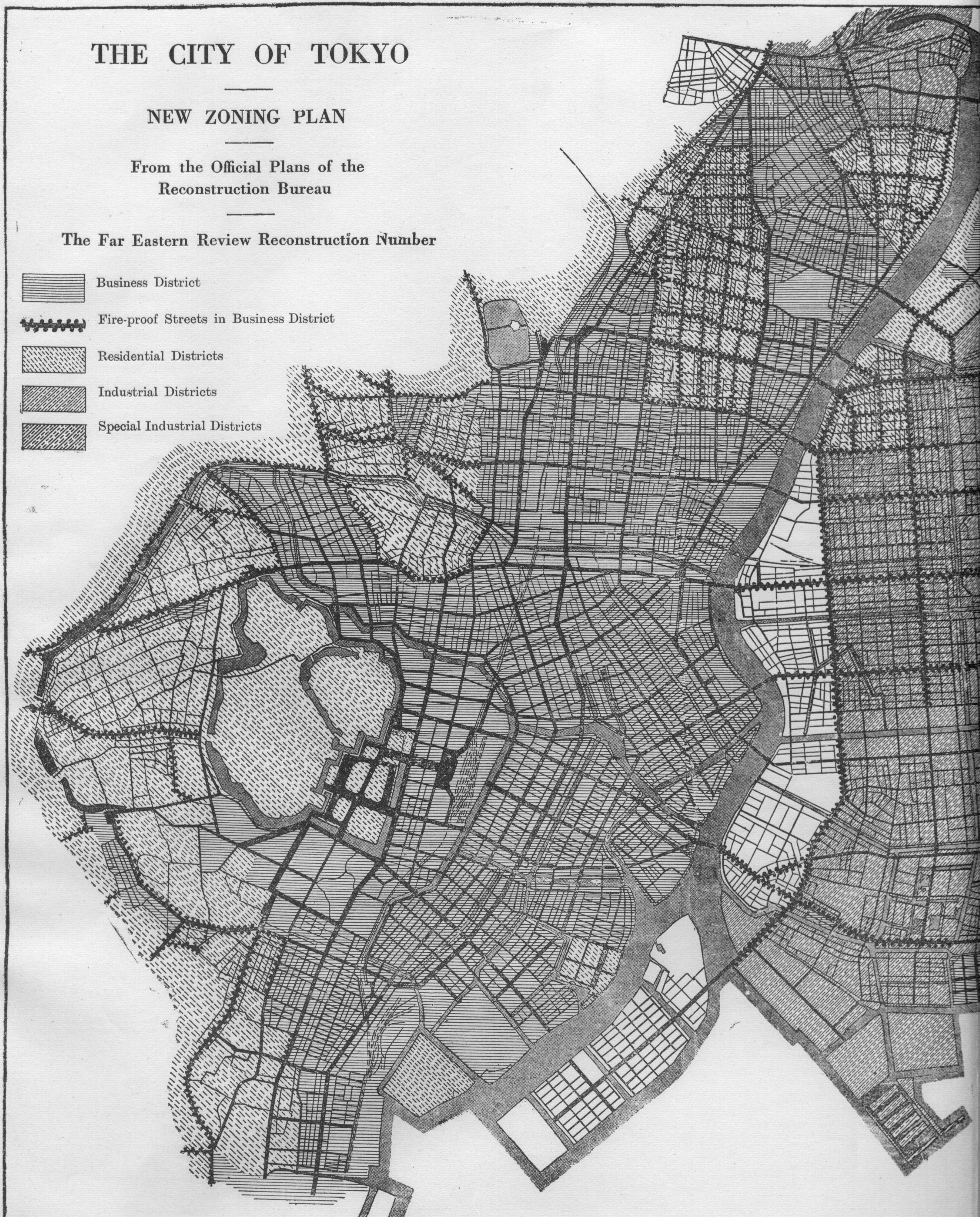
2.—Existing roads not entering into the reconstruction plan will be left undisturbed.

3.—Roads along which high speed railways are to be built must be at least 27 metres wide.

4.—Roads on which surface tram lines are to be built must be at least 22 metres wide.

5.—All roads planned in connection with the "Greater City Scheme" are to be constructed.

6.—Licensed tramways, especially those which have already purchased land for right-of-way privileges, shall be constructed.


THE CITY OF TOKYO
NEW ZONING PLAN
From the Official Plans of the
Reconstruction Bureau
The Far Eastern Review Reconstruction Number
Business District
Fire-proof Streets in Business District
Residential Districts
Industrial Districts
Special Industrial Districts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PLAN
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District

7.—The amount of sub-surface construction to be installed under roads shall in all cases be as limited as possible.

8.—Any widening of existing roads must be accomplished by increasing the width on both sides of the road to be altered.

9.—Only in those cases where it is absolutely necessary will it be permitted to disturb any structures of a permanent nature which successfully withstood the effects of the earthquake.

10.—Secondary roads of less than 22 metres in width and curved, and which cross other roads of similar width, shall be altered as little as possible in forming a part of the new road prgram.

11.—Roads built beside rivers and canals shall be so constructed as to provide sufficient space for the erection of storehouses and factories along the banks of such waterways.

12.—Efforts shall be made wherever possible to do away with crossings or street intersections consisting of more than two roads, In the event this is found to be impracticable, a suitable square shall be provided so as to permit the careful regulation of traffic.

13.—So far as possible, bridges shall not be built in such a way as to form an angle with the line of direction of the roads approaching it from either side.

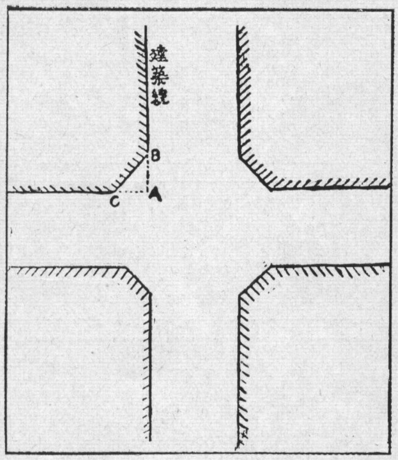
14.—Large drainage ditches shall be so covered that they may be utilized as a part of the road proper.

15.—All main roads shall be built of a width greater than that of any of the branches which may enter into it.

16.—The width of all main roads shall be from 2 to 4 times greater than the width of that portion of the road actually used by wagon traffic. Special attention should be given this condition in such districts as Nihonbashi-ku, in order that streets running through such congested districts may be provided with sufficient space to permit the building of sidewalks.

17.—The approaches to all bridges must be widened.

18.—The corners at road crossings shall be so constructed as to form an octagon at the street intersection in accordance with the sketch illustrated below :



(*a*) Roads of 6 to 9 metres in width may be built with corners parallel to the streets.

(*b*) Roads of 8 to 11 metres in width shall be built with corners 3 metres long.

(*c*) Roads of 11 to 22 metres in width shall be built with corners 4 metres long.

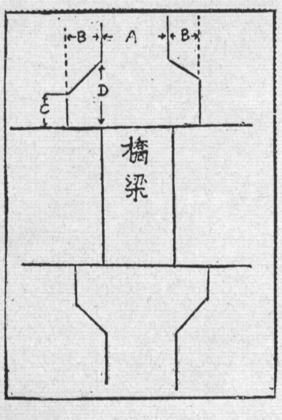
(*d*) Roads above 22 metres in width shall be built with corners 12 metres long.

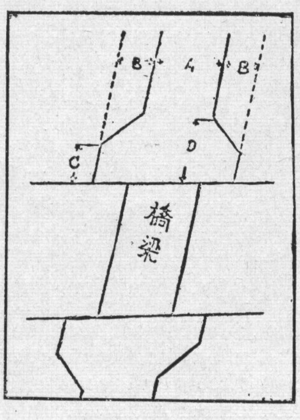
(*e*) These corners at all tram crossings shall be at least 8 metres long.

(*f*) The corners of streets intersecting in such a manner as to form obtuse angles at the crossings need not be built in accordance with the provisions of this article.

19.—Bridge approaches shall be laid out in various widths between 8 and 18 metres. The absolute minimum, however, must not be less than 6 metres in width.

The following sketches illustrate the standard dimensions to which all bridge ap proaches must conform, with the exception of those bridges having roads approaching at an angle, in which case these standards may be ignored.





"B" to be ½ "A" (smallest width 8 metres ; largest 18 metres)
"C" to be ½ "A" ,, ,, 6 ,, ,, 11 ,,)
"D" to be twice "C" (smallest width 12 metres; largest 24 metres)

All roads 11 metres and over in width shall be constucted so as to provide sidewalks on both sides of the road, and in accordance with the following schedule of dimensions :

Road Width	*Street Width*	*Width each Sidewalk*
36 metres	24 metres	6 metres
33 ,,	22 ,,	5.5 ,,
27 ,,	18 ,,	4.5 ,,
25 ,,	16.6 ,,	4.2 ,,
22 ,,	14.6 ,,	3.7 ,,
20 ,,	13 ,,	3.5 ,,
18 ,,	11 ,,	3.5 ,,
16 ,,	10 ,,	3 ,,
15 ,,	9 ,,	3 ,,
11 ,,	6 ,,	2.5 ,,

Where tram lines are in operation or are to be constructed along roads 22 metres wide, the above dimensions for this width road will be altered to 16.6 metres for the street width and 2.7 for the width of each sidewalk.

The horizontal slope at the intersection of all wagon roads shall be built to conform with the following grades indicated opposite the several kinds of road surfaces to be laid :

Road Surface	*Vertical Section*		
	(Within 1-50)	(Above 1-50) (Below 1-25)	(Above 1-25)
Asphalt			
Wood Block ..			
Concrete			
Brick			
Stone	1-40	1-60	1-80
Tar-Concrete ..	1-35	1-50	1-70
Tar-Macadam ..	1-30	1-45	1-60
Gravel	1-25	1-35	1-50

Where the vertical slopes of two adjoining roads vary by more than 1 in 100, the curve shall be constructed in accordance with the following standards :

Variation in Slope	*Length of Curve*
1-100 to 1-102	10 Metres
1-102 to 1-103	20 ,,
1-103 to 1-104	30 ,,
1-104 to 1-105	40 ,,
1-105 to 1-106	50 ,,
Above 1-106	60 ,,

Should the parabola or vertical curve be below 10 metres, the surface of such roads will be laid flat.

All ditches to be constructed along the sides of the roads must be built parallel to the line of the road itself.

Stone curbings between wagon roads and sidewalks must not be less than 9, or more than 20 centimetres in height, and, wherever possible, will be 11 centimetres high, which dimension will be regarded as the standard for this work.

Trees will be planted along the sides of all roads 25 metres or more in width. These trees will number 24,000 in accordance with the amount provided for by the budget.

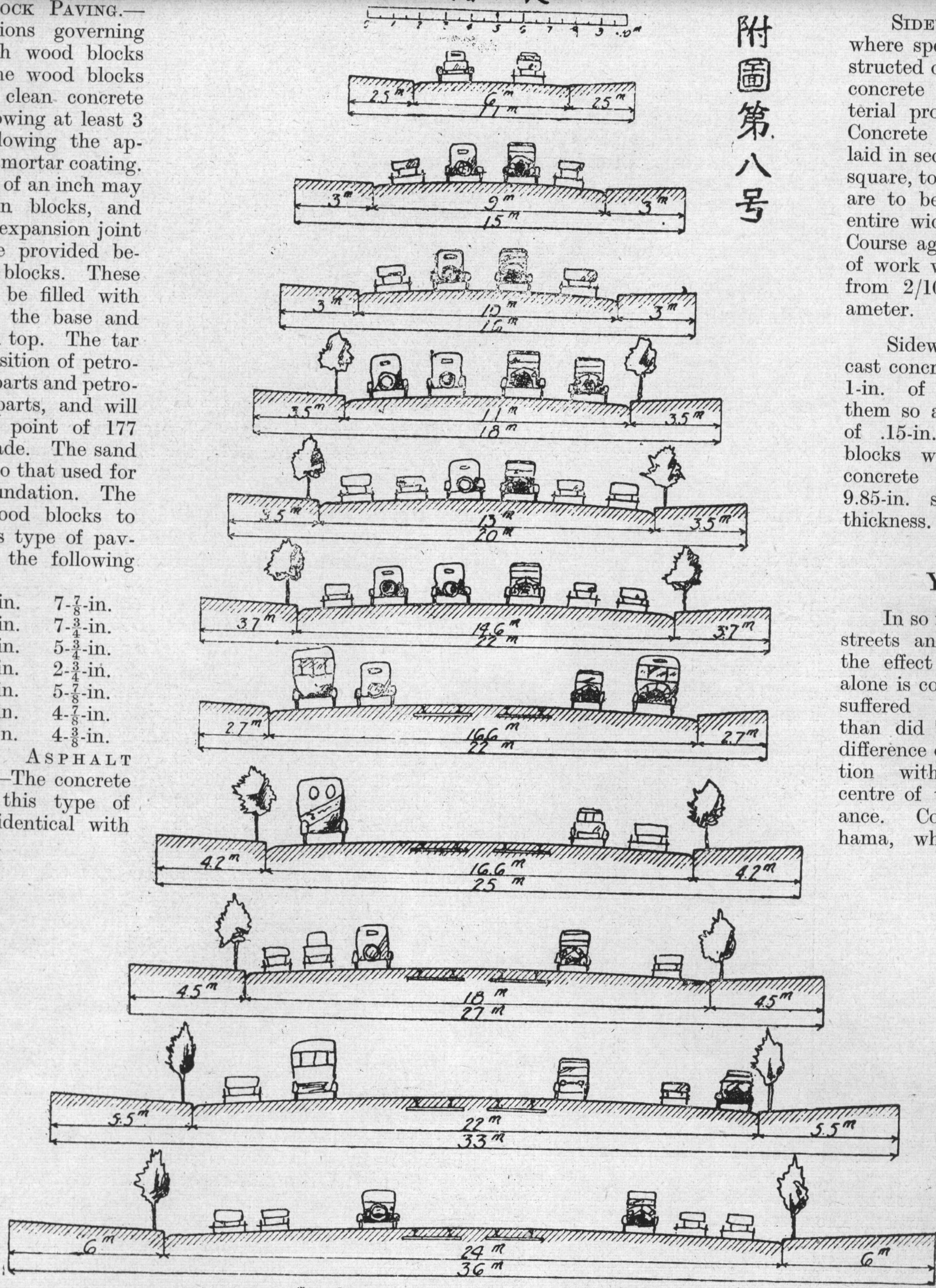
Roads to be paved in accordance with the present road building program will be surfaced with either wood blocks, asphalt blocks, sheet asphalt, rock asphalt, asphalt concrete or water-bound macadam. All roads irrespective of the nature of the surfacing will be laid on a concrete foundation of the following specifications :

After excavating to the standard depth specified, the surface will be hard rolled, using a road roller of not less than 8 tons weight. On this surface, 5-in. of good soil mixed with gravel will then be laid and rolled in, following which another layer, also 5-in. in depth, will be laid and hard rolled. The concrete foundation to be laid on this surface will be 6-in. in depth and will be of a 1 : 3 : 6 mixture, while the mortar coating over the concrete base will consist of a 1 : 3 mixture and will be laid at least 3/10 ths of an inch thick. Course agregate for the concrete work will consist of gravel not more than 1-in. in diameter, and sand will be of a hard gritty quality free from loam.

Wood Block Paving.—The specifications governing roads laid with wood blocks require that the wood blocks be laid on a clean concrete foundation, allowing at least 3 days' time following the application of the mortar coating. A space of 0.15 of an inch may be left between blocks, and every 36-ft. an expansion joint of $\frac{1}{2}$-in. will be provided between rows of blocks. These interstices will be filled with 2-in. of tar at the base and 1-in. of sand on top. The tar will be a composition of petroleum asphalt 7 parts and petroleum pitch 3 parts, and will have a melting point of 177 degrees Centigrade. The sand will be similar to that used for the concrete foundation. The sizes of the wood blocks to be used for this type of paving will be of the following dimensions :

3-$\frac{5}{8}$-in.	3-$\frac{3}{4}$-in.	7-$\frac{7}{8}$-in.
3-$\frac{5}{8}$-in.	3-$\frac{3}{4}$-in.	7-$\frac{3}{4}$-in.
3-$\frac{5}{8}$-in.	3-$\frac{3}{4}$-in.	5-$\frac{3}{4}$-in.
3-$\frac{5}{8}$-in.	3-$\frac{3}{4}$-in.	2-$\frac{3}{4}$-in.
3-$\frac{5}{8}$-in.	2-$\frac{3}{4}$-in.	5-$\frac{7}{8}$-in.
3-$\frac{5}{8}$-in.	2-$\frac{3}{4}$-in.	4-$\frac{7}{8}$-in.
3-$\frac{5}{8}$-in.	2-$\frac{3}{4}$-in.	4-$\frac{3}{8}$-in.

Petroleum Asphalt Block Paving.—The concrete foundation for this type of paving will be identical with that on which wood block paving will be laid. The petroleum asphalt blocks will be 5-in. wide by 1-ft. long by 2-in. in thickness, and will be laid end to end, allowing no spaces between them. Fine sand will then be sprinkled over the surface of the blocks in the quantity of 0.2 cubic foot of sand to 1 *tsubo* of paved area.



Standard Plans for Tokyo's New Streets

Asphalt Concrete Paving.—Not sooner than 10 days following the completion of the concrete foundation the asphalt surface for roads surfaced with this material will be laid to a depth of 1.8-in. The asphalt to be used for this work will be of a grade having a melting point of 140 degrees Centigrade, and will be applied in the quantity of 2 *sho* (about 1 standard gallon) per *tsubo* of road surface. After rolling, this surface will be sprinkled with a fine grade of sand to a depth of about one-tenth of an inch.

Macadam Roads.—Roads paved with gravel, crushed rock, etc., shall be provided with a concrete foundation similar to that specified for wood-block paving. The surfacing materials for this type of road must be laid in such a manner as to produce a finished depth of at least 6 inches following the rolling with a 10-ton macadam road roller. Fine gravel and pulverized stone will then be used for the top surfacing, which after rolling may or may not be bound with tar having a melting point of 177 degrees Centigrade.

Sidewalks. — Sidewalks where specified are to be constructed of concrete or pre-cast concrete blocks made in material proportions of 1 : 2 : 4. Concrete sidewalks are to be laid in sections or frames 3-ft. square, to a depth of 3$\frac{1}{2}$-in., and are to be laid flat across the entire width of the sidewalk. Course aggregate for this class of work will consist of gravel from 2/10ths to 1-in. in diameter.

Sidewalks laid with precast concrete blocks shall have 1-in. of sand spread over them so as to fill the spaces of .15-in. left between the blocks when laid. These concrete blocks are to be 9.85-in. square by 2-in. in thickness.

Yokohama

In so far as the damage to streets and roads caused by the effect of the earthquake alone is concerned, Yokohama suffered considerably more than did Tokyo, due to the difference of 18 miles in location with respect to the centre of the seismic disturbance. Consequently, Yokohama, while not having a road construction program which could be in any way compared with the extensive plans laid out for Japan's capital city, has, however, a very much deserved and badly needed road program, consisting of 129,893 metres in length and comprising 421,000 *tsubo* in area. Details of this construction program are as follows :

	Length *metres*	Area *tsubo*
Roads to be built by the National Government ...	30,534	215,000
Roads to be built by the Municipality	12,814	67,000
Roads to be built as part of the Land Adjustment Scheme (both by the National Government and by the Municipality).	86,545	139,000
Total	129,893	421,000

Of the roads to be built by the National Government, 77 per cent. of the surveys have been completed and 14 per cent. of the plans, and work has already been commenced on the first avenue extending from Takashima-Cho along the reclaimed land.

The following schedule outlines the extent of the work to be undertaken by the Reconstruction Bureau in providing Yokohama with new streets and roads, and indicates as well the progress made up to December 31, 1924.

Road Number	Location	Width Metres	Length Metres	Percentage of Work Completed
1.	Kyobashi Cho to Hodogaya Iwama	18-36	8,505	0.03
2.	Bentenbashi to Bankoku Bashi	27	627	—
3.	Honcho 4 chome, to Ooka Machi	23-25	4,520	—
4.	Oe Bashi to Honmoku ...	23-25	4,710	—
5.	Aoki Cho 7 ken cho, to Rokkaku Bashi	22	2,182	—
6.	Hodogaya Tanimachi, to Minami Yoshida Machi, Yotsume	16-22	3,737	—
7.	Hiraoka Bashi to Senshu Bashi	18-22	2,785	—
8.	Idogaya to Hodagaya Machi Iwama	18-22	1,421	—
9.	Sákuragi Cho 1 chome to Hinode Cho, 1 chome ...	16	546	—
10.	Hiranuma Machi to Yokohama Station	22	567	—
11.	Kanagawa Machi, Jubancho, to HigashiK anagawa Station	27	229	—
12.	Hiranuma Machi to Sengencho	22	709	—

The building of new roads will be the chief work of the Reconstruction Bureau. For the construction of main avenues the national government will appropriate Y.282,840,000. For the construction of new streets to be laid out in connection with the land adjustment scheme, a further Y.41,760,877 will be granted as subsidies. It will also lend Y.43,510,402 to the local governments, making a grand total of Y.368,112,079 to be expended on the new roads scheme. To this, must be added Y.23,497,100 granted as loans and subsidies to the local governments for repairing roads and bridges damaged by the earthquake and fire.

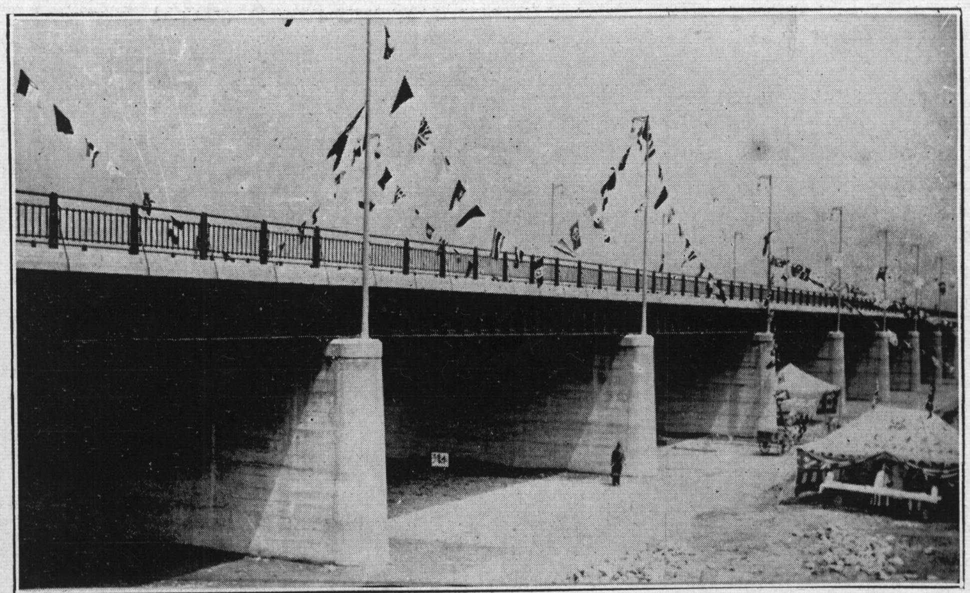
THE STREETS OF TOKYO
Top: Looking down from Uyeno Park
Center: The New Ginza
Bottom: Minamidenma-cho from Kyobashi

The total expenditure on new streets in Tokyo will be Y.318,310,000. Of this amount, Y.60,852,000 will be charged against the municipality, and one half (Y.30,426,000) paid by the national government as a direct subsidy. This makes the national government's expenditure on new roads in Tokyo, Y.281,884,400. The municipality will, however, pay interest on the Y.30,426,000 to be advanced by the national treasury. On road repairs, Y.16,-055,100 will be spent in Tokyo, the national Government paying Y.6,689,625, lending the balance to the municipality and advancing the interest charges in the form of further loans. This brings the national government's share of the costs of new roads and road repairs in Tokyo to Y.288,574.025, spread over a five-year period, 1923-24 to 1928-29.

In Yokohama the national government will spend Y.25,382,400 on new main roads, and grant the municipality a loan of Y.3,009,000 and subsidy of Y.3,009,000 for the same purpose. Yokohama will be obliged to assume the interest charges on this loan. An additional Y.7,442,000 has also been granted the Yokohama municipality for road repairs, the national government assuming, in the form of a subsidy, 5/12ths of the total, Y.3,100,833. The balance, Y.4,341,167, will be loaned to the municipality by the national treasury,which will also advance the interest charges. This brings the national government's expenditure in Yokohama (Y.28,391,400 for new roads and Y.3,100,833 for repairs) to Y.28,391,400.

The prefectural governments of Tokyo and Kanagawa are also granted subsidies and loans from the national treasury to enable them to complete the construction of certain national roads planned before the earthquake, as well as certain subsidiary roads. The grants to Tokyo prefecture aggregate Y.17,083,204, of which Y.7,583,506 is a subsidy, and Y.9,499,698 a loan from the national treasury on which the prefecture must

assume the interest charges. To Kanagawa prefecture Y.1,318,075 has been allotted for completing that part of the first national road between Tokyo and Yokohama within its borders. Of this, Y.500,000 has been set aside for building the important bridge over the Rokugo (Tama) river at Kawasaki. The nation will pay Y.742,371 as a subsidy for this work, the prefecture assuming the interest charges on the balance, Y.575,704, which will be advanced to it in the form of a loan from the national government.



New Steel Girder Bridge carrying the 4th National Highway over the Arakawa River at Senju

and Shinkai Bashi is now in course of construction.

7th National Road: from Kameido Suijin Shrine to Asakusa Michi, known as the Chiba Kaido, construction to begin shortly. Total length, 1,140 *ken*.

9th National Road, called the Nakasendo, will be extended from Sugamo Machi to Itabashi Machi, a distance of 1,620 *ken*. Land is now being purchased for the road site.

The estimated cost of these roads is Y.7,606,121, of which the national government will pay one-half as a subsidy. Costs of construction completed by the end of December, 1924, were Y.5,406,000.

Tokyo Pefecture's Road Plans (*See Map*)

In 1919 a scheme for the constuction of a belt road around Tokyo from north to south and east to west, together with subsidiary roads radiating into the country and the city, was approved by the prefectural assembly at a total cost of Y.18,047,500 spread over a period of 8 years. This was later extended, and approved in October 1921 by the Department of Home Affairs, at a total cost of Y.43,885,452, spread over 8 years from 1921 to 1929.

This new plan embraced the construction of 14 first-class roads, 72-ft. wide, with a wagon road of 54-ft. and sidewalks 9-ft. wide on both sides of it; 8 second-class roads, 60-ft. wide; and 11 second-class roads, 48-ft. wide. One-third of the costs are covered by a subsidy by the national government, in addition to the subsidy of one-half granted for the construction of national roads, of which four are being built by Tokyo prefecture.

The Home Department approved a scheme which gives the prefecture the right to levy taxes on all property for 360-ft. on both sides of the proposed roads up to 10/75ths of its value, to help defray the costs of construction. Holders of ten-year leases and mortgages are also liable to this tax.

All the roads laid in accordance with this plan are to be macadamised. Foundations will be rolled about 3.5-in. thick, and the surface gravel bound with tar. Sidewalks will be built 6-in. deep, 3-in. foundation, 2-in. rolled in gravel, and a surface 1-in. thick. Concrete will, however, probably be used for all sidewalks laid in future. All bridges to be built in connection with these roads will be at least 18-ft. long, and built on permanent foundations of concrete and steel. Bridges 180-ft. long will all be built the same width as the roads.

National roads now being built by Tokyo prefecture are: 1st national road, between Shinagawa and the Rokugo river. Construction has been completed from Yatsuyama to Omori and opened to traffic for a distance of 2 miles.

4th National Road: from Senju Ohashi to Umejima Mura, a distance of 17,040 *ken*, of which 360 *ken* between Senju Ohashi and Shinkai Bashi is now in course of construction.

In pursuance of the plan for a belt road around Tokyo city, and subsidiaries thereto, Tokyo prefecture is constructing the following roads:—

1. From Shinagawa, Yatsuyama to Osaki Yazaeke, 6,000-ft., of which a large part has been competed. Cost of construction: Y.1,523,548.

2. From Meguro Machi office to Meguro Hikawa Shrine, 5,160-ft. Now under construction at a cost of Y.430,553.

3. Sendagaya to Yotsuya, 3,840-ft. Cost of construction Y.419,660.

4. From Sugamo, Ikebukuro, to Koshinzuka, 4,920-ft. Cost of construction, Y.812,994.

5. Kinomoto, Mikawajima, to Minami Senju, 3,980-ft., of which 2,530-ft. are now completed. Total cost of construction estimated at Y.361,034.

6. Komurai Azumacho to Kameido, 3,620-ft. Cost of construction, Y.1,585,508.

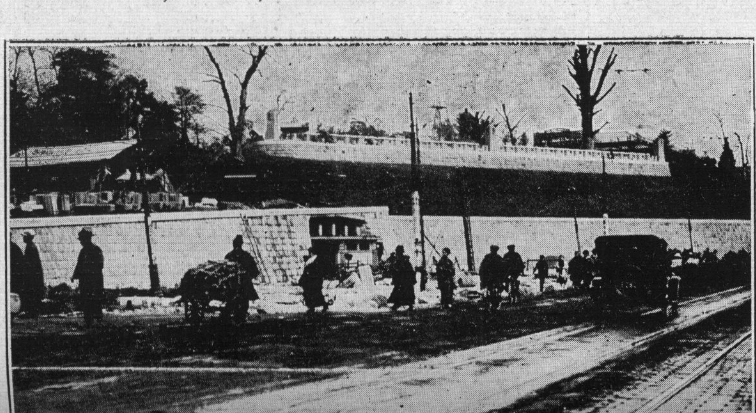
7. Osaki Machi to Osaki Station, 1,440-ft. now under construction. Total estimated cost of construction, Y.119,132.

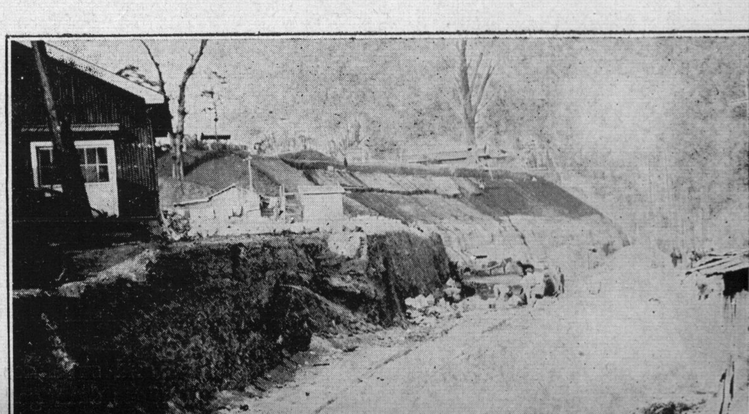
9. Shibuya Machi to Meguro District Office, 3,040-ft., of which 2,160-ft. are now finished. Total cost of construction, Y.1,041,810.

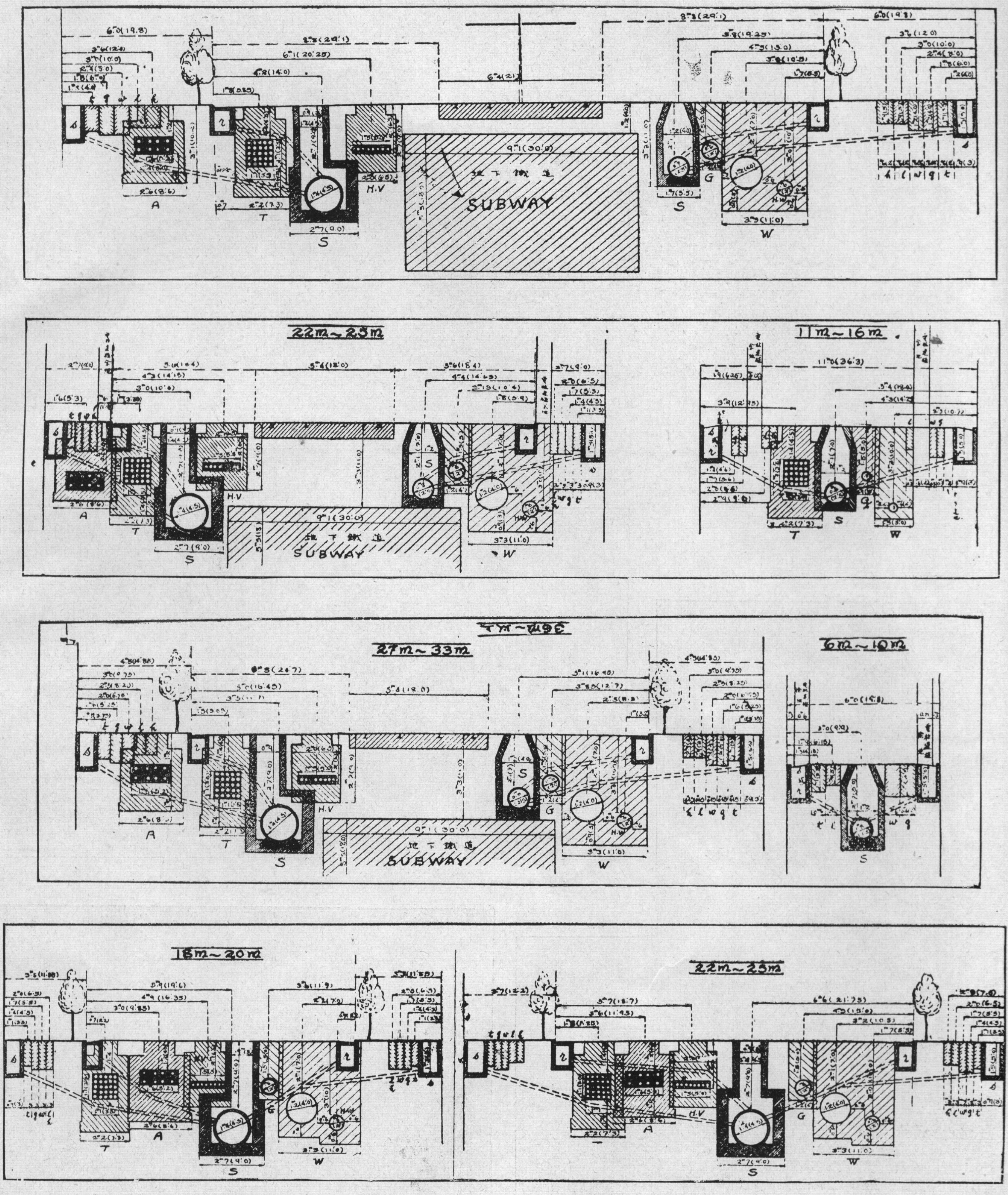
9. Nishi Sugama to Ikebukuro, 4,800-ft. Cost of construction, Y.880,762.

Sub-Surface Construction

The principal thoroughfares of Tokyo, with the existing mass of telephone, telegraph and electric light poles, etc., present a sight to-day which is far from being one of picturesqueness. Not only do these obstacles detract from the beauty of the streets of Japan's capital city, but they also seriously hinder the efficient handling of the constantly increasing traffic problems with which Tokyo is at the present time confronted. Also the fact that all work in con-



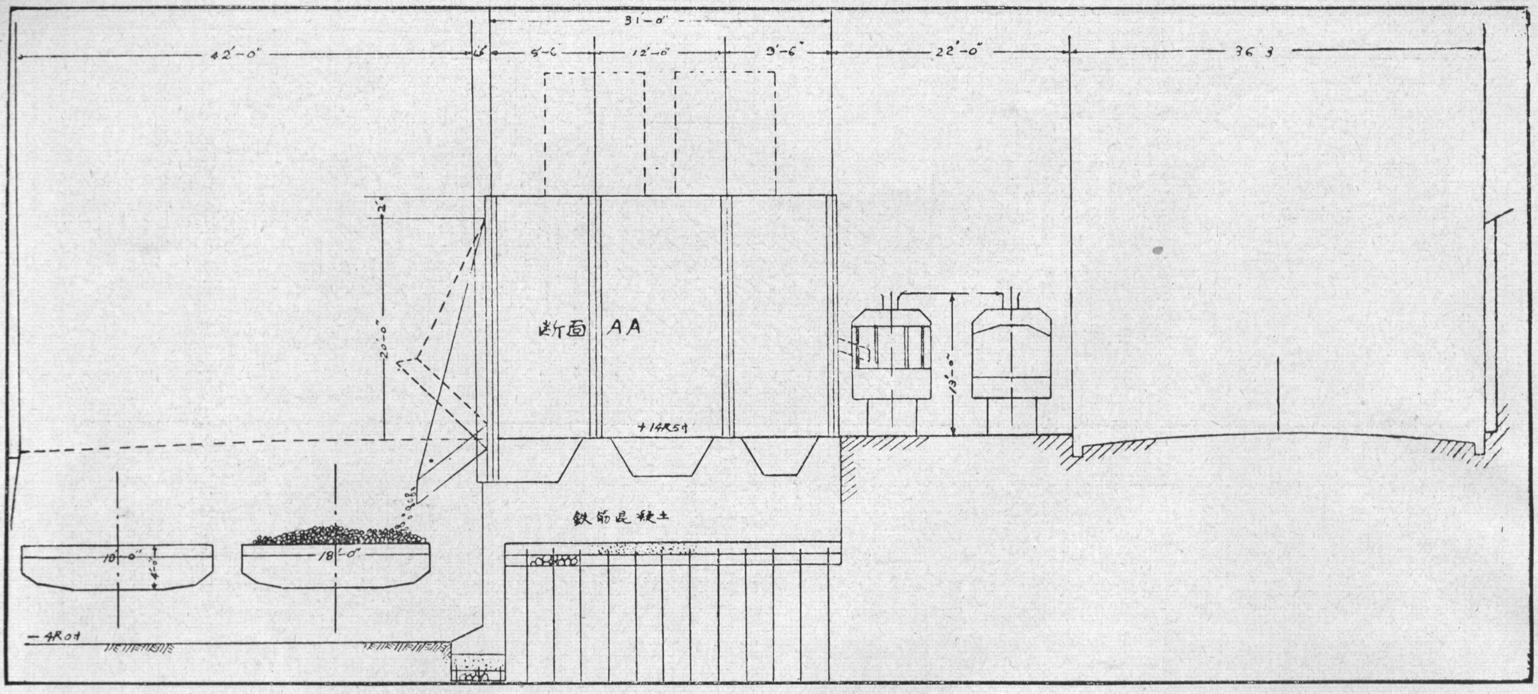




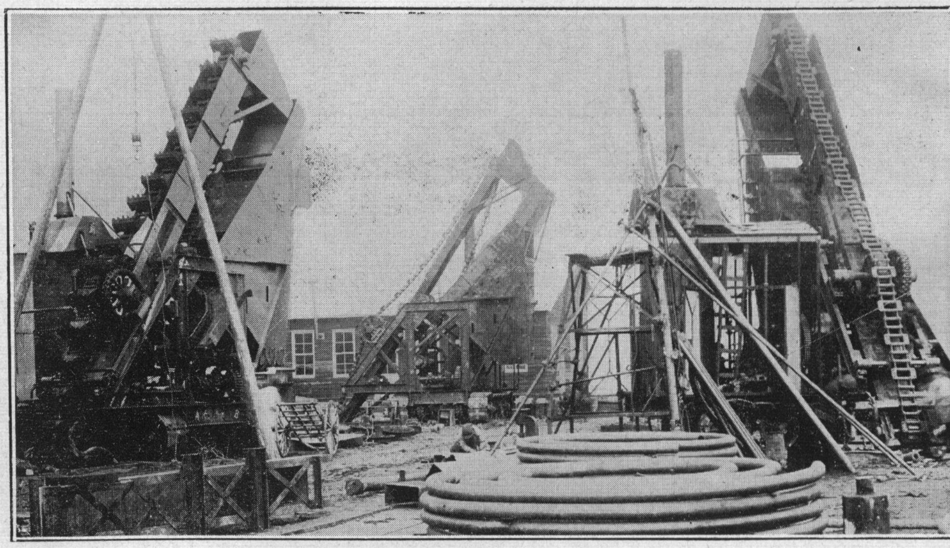
SUB-SURFACE PLANS FOR TOKYO'S NEW STREETS

T .... Telegraph and Telephone Wires
t .... Branch ,, ,,
H.V ...... High Tension Transmissson Lines
h .... ,, ,, ,, ,,
] .... Electric Light Branch Lines

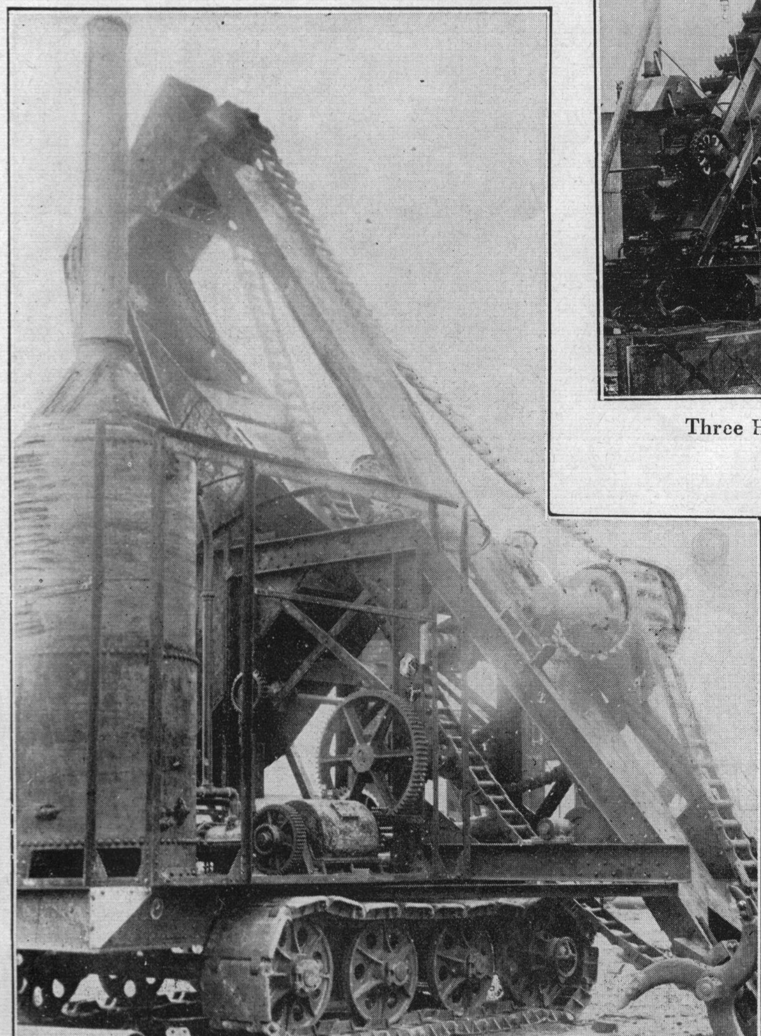
A .... Pneumatic Tubes; Diameter 2¼ in.
W ...w... Water Mains
S .... Sewers, (r) rain water, (s) sewage
G ...s ... Gas Mains and Pipes
Subways



Iida-machi Gravel Storage Bins, Tokyo

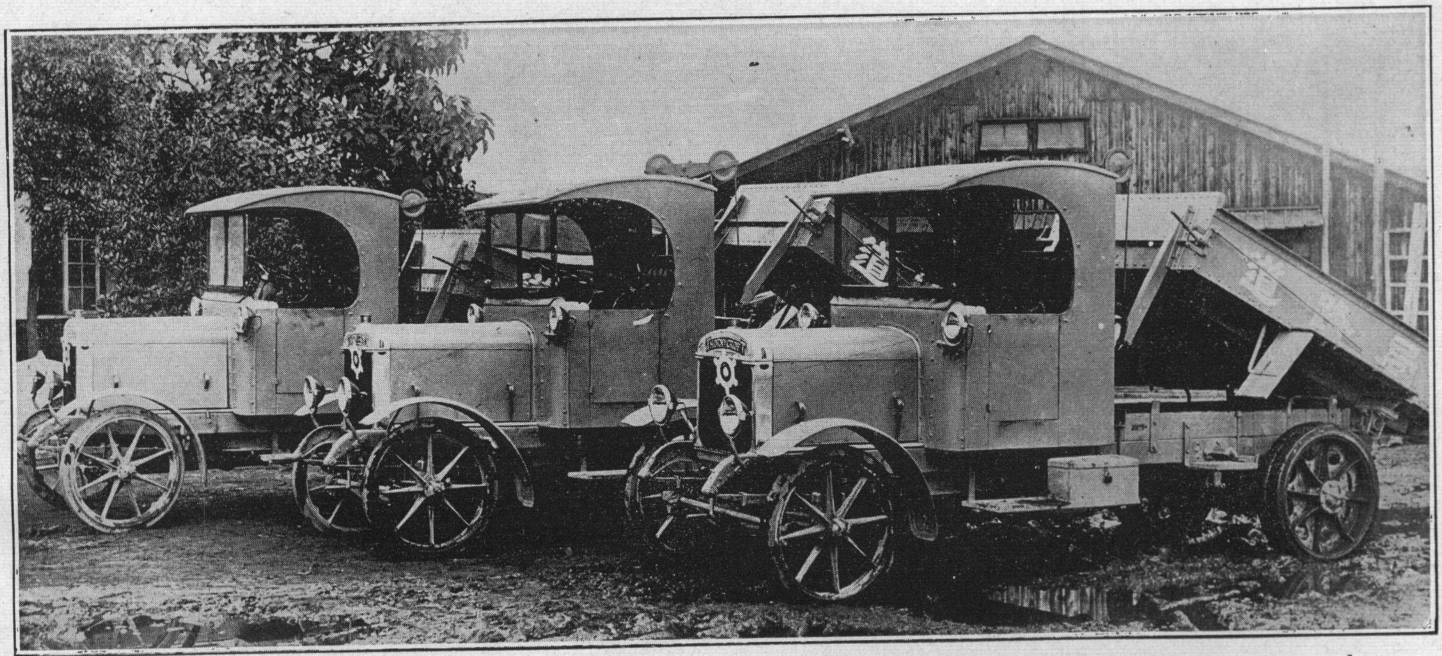


Three Hayashi Gravel Collecting Machines owned by Reconstruction Bureau



Three Hayashi Gravel Digging Machines built in Japan and used by the Reconstruction Bureau in Collecting Gravel from the River Beds

Minami Senju Gravel and Material Yard



Three Thornycroft type "BT" 2-ton Tipping Wagons in use by the Tokyo Municipal Roads Bureau for reconstruction work

nection with the repair and extension of the various types of sub-surface construction has always been carried out under the direct supervision of the particular department responsible for its maintenance and expansion, little thought has seldom been given to making an attempt at co-ordinating with the activities of other departments. As a result, one frequently found that streets which had been opened to traffic for but a week or two following a period during which work was being conducted by some certain department would again be closed to traffic while the activities of another department were undertaken. It is reported that Irvin S. Cobb once expressed wonderment as to whether New York would ever get out of the "trenches," and it is more than likely that most of Tokyo's permanent residents have at some time or other had ample justification for expressing similar wonderment.

The Reconstruction Bureau in order to correct these conditions has laid out a very complete and comprehensive program, requiring that all such future construction, wherever possible, be installed below the level of the ground and in accordance with the new standards of sub-surface construction illustrated in the sketches accompanying this article. All work of this character is to be submitted for the approval of the Reconstruction Bureau prior to installation and is to be completed before any work on the road itself is commenced. By following this procedure only an emergency will thereafter justify any disturbance of the road surface.

An estimate was made shortly before the September 1923 disaster for the purpose of determining the amount invested in Tokyo alone in this class of public utilities. The figure arrived at indicated a total of Y.149,450,000, the proportionate amounts represented by each of the various utilities engaged in making up this total being stated below :

Communications Department (telephone and telegraph lines)	Y.41,811,000
Police Bureau (telephones)	2,533,000
Tokyo City Electric Bureau (light and power lines)	27,622,000
Tokyo City Waterworks Bureau (water mains, etc.)	15,500,000
Tokyo City Sewer Bureau (sewers).. ..	10,162,000
Tokyo Electric Light Co. (electric power lines)	39,822,000
Tokyo Gas Co. (gas mains)	12,000,000
Total ..	149,450,000

Of the total land area of Tokyo, comprising some 24,000,000 *tsubo* (1 *tsubo*=36 sq. ft.), approximately 11,000,000 *tsubo*, or nearly one-half of the entire city, was destroyed by the September 1923 fire following the earthquake. The damage sustained by that portion of the public utilities located within the devastated area of th ecity was estimated at Y.112,353,000, or more than 75 per cent. of the total represented in the above table. Some idea of the extent of this damage may be obtained from the following detailed figures :

Communications Department	Y.31,209,000
Police Bureau	1,477,000
Tokyo City Electric Bureau	17,116,000
Tokyo City Water Works Bureau ..	14,525,000
Tokyo City Sewer Bureau	8,786,000
Tokyo Electric Light Co.	28,512,000
Tokyo Gas Co., ...	10,728,000
Total ..	Y.112,353,000

Not only has the progress in the work of repairing these damages been rapid, but additional installations made since the 1923 estimate of Y.149,450,000 was taken has increased the value represented by these public utilities to approximately Y.200,000,000, including both sub-surface and overhead construction.

A survey recently made by the Reconstruction Bureau estimates that a total of Y.2,034,000 will be required to complete the work of both repairing and installing underground certain of these utilities which are to be located along the new roads provided for in the advanced road building program of that bureau. This sum will be divided into two parts, Y.1,400,000 to be allocated to sub-surface construction, while the remaining Y.634,000 will be utilized in making the necessary repairs and alterations to the existing overhead construction. The enormous amount of work involved in this program may be partially visualized from the following figures giving in *ken* (1 *ken*=6-ft.) the extent of the roads along which this work is to be undertaken :

Telephones :	
(*a*) Underground	128,600 ken
(*b*) Overhead	2,158,000 ken
Police Telephones :	
(*a*) Underground	2,200 ken
(*b*) Overhead	15,400 ken
Tokyo Electric Light Co. :	
(*a*) Underground	7,500 ken
(*b*) Overhead	30,700 ken
Light and Power Supply Lines :	
1—Municipal Electric Bureau	
(*a*) *Underground*	101,400 *ken*
(*b*) Overhead	800 ken
2-Tokyo Electric Light Co.	
(*a*) Underground	171,500 ken
(*b*) Overhead	372,000 ken

Main Transmission Lines :	
1—Municipal Electric Bureau	
(*a*) Underground	6,300 ken
2—Tokyo Electric Light Co.	
(*a*) Underground	81,200 ken
Tokyo City Water Works Bureau :	
(*a*) Water mains	102,400 ken
Tokyo City Sewer Bureau	
(*a*) Sewers	293,400 ken
Tokyo Gas Company	
(*a*) Gas mains	548,600 ken

This type of construction, especially that to be placed underground, will require the expenditure of considerable time and money. One example of this may be cited in quoting the estimated cost involved in adjusting the water mains and branches to conform to the new standards recently prescribed by the Reconstruction Bureau. This work alone will cost Y.20,000,000, although the appropriation set aside by the Diet to carry out this particular undertaking amounted to Y.7,000,000, or but 35 per cent. of the total estimated cost. The 2,000,000 *ken* of roads which will be constructed within the next five years will entail a cost estimated at Y.145,000,000. Of this amount approximately 30 per cent. or Y.43,500,000 will be devoted to the construction of sub surface structures.

Gravel Requirements for Reconstruction.

For reconstruction work alone it is estimated that 200,000 cubic *tsubo* (43,200,000 cubic feet) of gravel will be required during the five-year period extending from 1924 until 1929. This material will be used entirely for the surfacing of unpaved roads and for use as course aggregate in connection with reinforced concrete construction.

Before the earthquake the total annual requirements of the city of Tokyo averaged between 140,000 and 170,000 cubic *tsubo* (1 cubic *tsubo*=216 cubic feet), of which quantity the municipality was the largest individual consumer. Most of the gravel formerly used in this district was obtained from the beds of rivers located adjacent to the city. Constant working of these rivers, however, has practically exhausted the available supply, and Tokyo is now confronted with the necessity of seeking new gravel deposits, located at such distances from the city as to materially increase the ever-difficult problem of transportation. Freight has always been the chief item contributing to the high cost of gravel sold for Tokyo delivery, and of the present selling price, averaging between Y.34 and Y.35 per cubic *tsubo*, transportation charges alone represent Y.25 of this amount. Moreover, the price tendency is distinctly upward.

Prior to the earthquake the principal rivers from which Tokyo's gravel requirements were obtained, together with an average of the amount produced by each over a period of one year, were as follows :

Location	*Transported by Rail*	*Transported by Water*
Tamagawa (Tama river) ..	80,000 cubic tsubo	33,000 cubic tsubo
Arakawa (Ara river) ..	15,000 ,, ,,	— ,, ,,
Tonegawa (Tone river) ..	5,000 ,, ,,	— ,, ,,
Sagamigawa (Sagami river)	7,000 ,, ,,	— ,, ,,
Total	107,000 cubic tsubo	33,000 cubic tsubo
	33,000 ,, ,,	
Grand Total ..	140,000 cubic tsubo	

This total average, amounting to 140,000 cubic *tsubo* of gravel, consumed annually within the Tokyo district was absorbed as follows :

Tokyo municipality	63,000 cubic tsubo
Tokyo prefecture	10,000 ,, ,,
Government departments	7,000 ,, ,,
Private companies	60,000 ,, ,,
Total	140,000 cubic tsubo

Generally speaking, those companies engaged in fulfilling the local demands for gravel operate on a very limited capital and with an exceedingly small margin of profit, and are, therefore, not in a position to materially increase their output. Consequently, the enormous increase in gravel requirements for both Tokyo and Yokohama during the next five years has presented a problem of such importance as to require the Reconstruction Bureau to make special provision in order to insure an adequate supply of this material for use in the reconstruction of these two cities.

Ten central gravel storage bins will be erected by the Bureau at Iidamachi, Tokyo, at a total cost of Y. 1,000,000. These bins will be of reinforced concrete design, of 100 cubic *tsubo* capacity each, and cover an area of 2,000 *tsubo*. The gravel depot upon completion will be equipped to receive, store and discharge 300 cubic *tsubo* (64,800 cubic feet) of material daily. The cars containing the material will be shunted direct to the bins over an elevated line to be constructed from the steam tram terminal at Iidamachi, the Tokyo terminus of the Central (Chuo) railway line, and will discharge at that point direct from the cars into the bins. Each bin will be equipped with shutes permitting the gravel to be discharged either into barges lying in the canal passing through Iidamachi or into waiting motor trucks located on the road side of the depôt.

In order to obviate any possibility of experiencing a shortage of gravel due to delay in transportation, the Reconstruction Bureau has concluded arrangements with the Imperial Government Railways for the purchase of 200 steel hopper type cars of 30 tons capacity each.

In addition to this equipment, 100 barges of a capacity of 20 to 25 tons each will be purchased for use in transporting gravel to convenient locations so as to facilitate local distribution. More than 70 motor trucks, the majority of which are G. M. C. and Mack trucks of 2½ tons capacity, are operated by the Reconstruction Bureau at the present time in transporting sand, gravel and other materials from the several material storage yards to the various locations where construction work is in progress.

Due to the excessive cost of land within the city limits, the Reconstruction Bureau has found it impossible to erect storage bins of sufficient capacity to accommodate a supply of gravel which will meet the severe demands bound to obtain from time to time during the progress of reconstruction. To offset this situation, a storage yard has been established at Minami Senju, where accommodations are provided for the storage of an additional 20,000 cubic *tsubo* of gravel. The material will be carried to this storage yard in barges, where it will be unloaded by means of a Goliath travelling crane equipped with clamshell buckets. These two distributing centers, combined with the storage yard to be established on the site recently procured in Shibaura, will not only complete a system of central storage points which will considerably accelerate the delivery of gravel in various parts of the city of Tokyo, but they will also assist in bringing about a reduction in the excessive transportation costs now existing in connection with shipments of this most essential of construction materials.

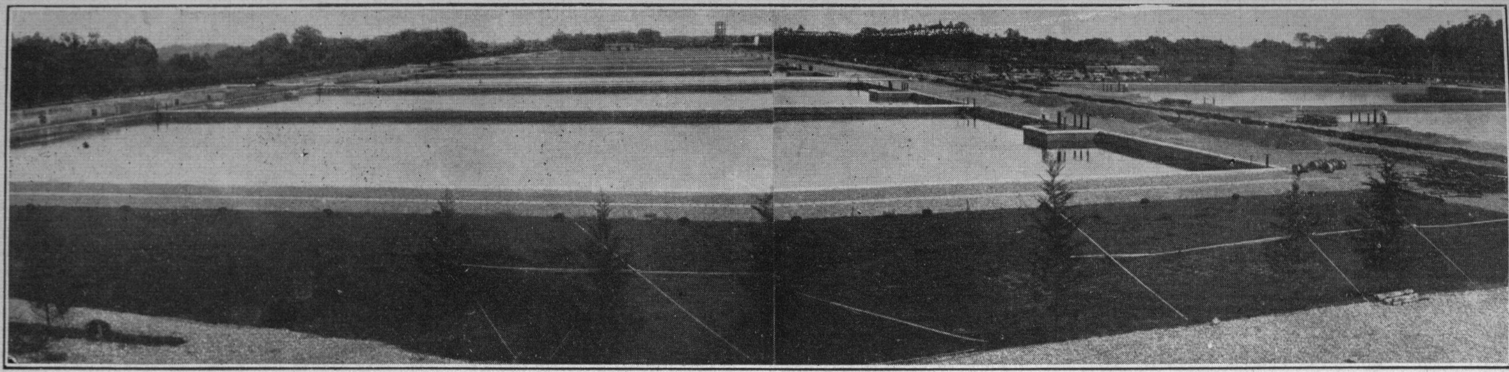
The photographs accompanying this article illustrate a machine invented by a Japanese, and designed especially for collecting gravel located in shallow water. Three machines of this type are now being operated by the Reconstruction Bureau.

Japanese Road Construction Companies

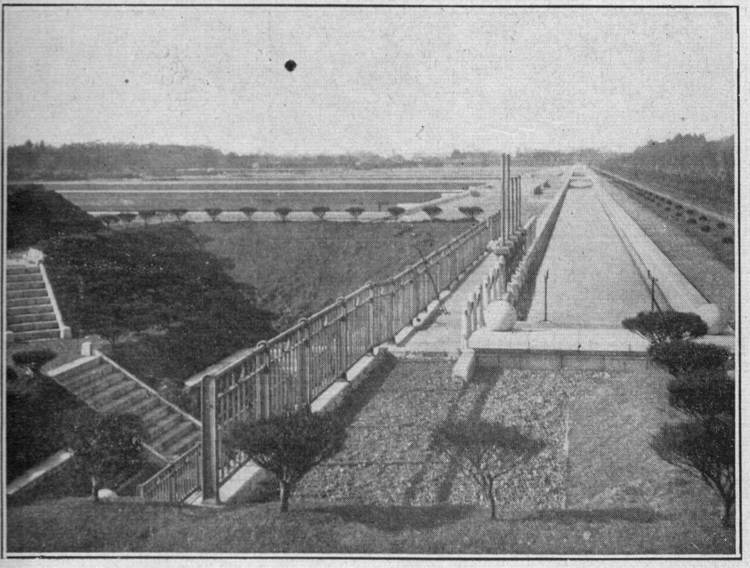
The problem of street paving in Tokyo is of the highest importance from every point of view. The municipal authorities realize the magnitude of this problem, and toward its solution a great deal of progress has been made. Naturally progress has been comparatively slow to date ; first, because proper construction equipment had to be decided upon and imported, and second, because the Japanese contractors had to readjust themselves and their organizations to what is a new business in Japan.

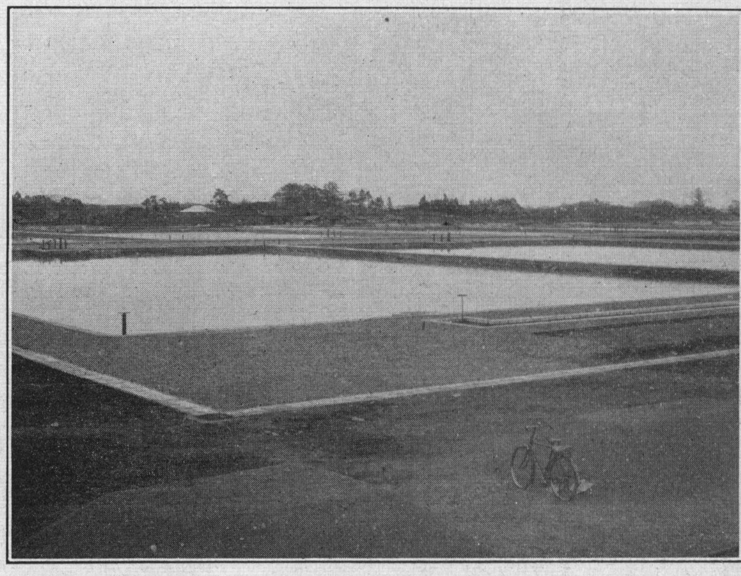
Many engineers have gone to America and Europe to study roads, machinery, methods and equipment, and at present Japan posesseses a wealth of knowledge on the subject that is just beginning to be put into practice. Many of these engineers have been sent by the Municipality of Tokyo and many others as employees of private concerns interested in paving contracting and desirous of having engineers properly trained in up-to-date methods.

Until quite recently it has been customary in Japan for the municipal, prefectural and imperial governmental bodies to do their own paving work, but there is now a tendency to let the work out by contract to construction companies who are able to operate more economically and efficiently. This system prevails in American cities, and in view of the trend in Japan to follow this example, various companies are being equipped in order to secure some of the paving construction in Tokyo during the next few years.

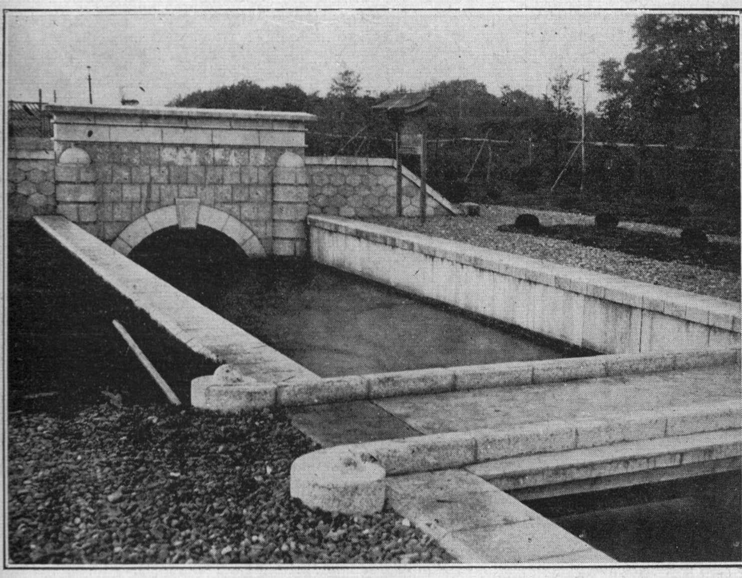


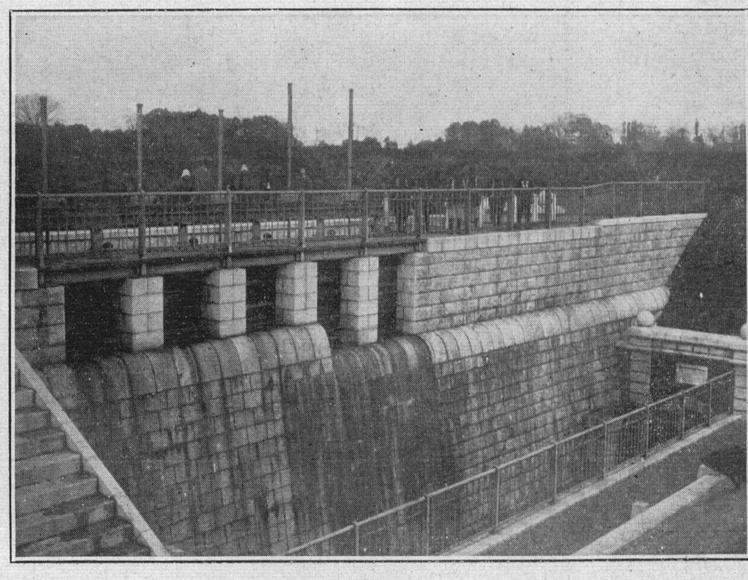
Sakai Filter Beds





Intake Canal and View of the Sakai Filter Beds





SAKAI FILTER BEDS

Inlet Open Canal

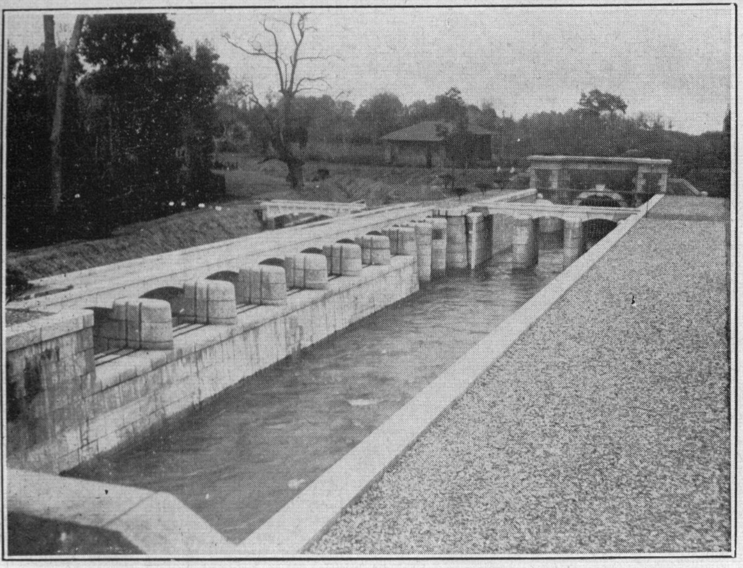
Submerged Weir at Terminal of Open Canal

Higashi, Muruyama, Koganei and Musashino. The length of the line is about 7 miles with a gradient of 1-1,000 and 1-1,200 according to the location. The water depth is 5.6-ft. for the tunnel and 6-ft. for the conduit with a flow of 250 cu. ft. per second.

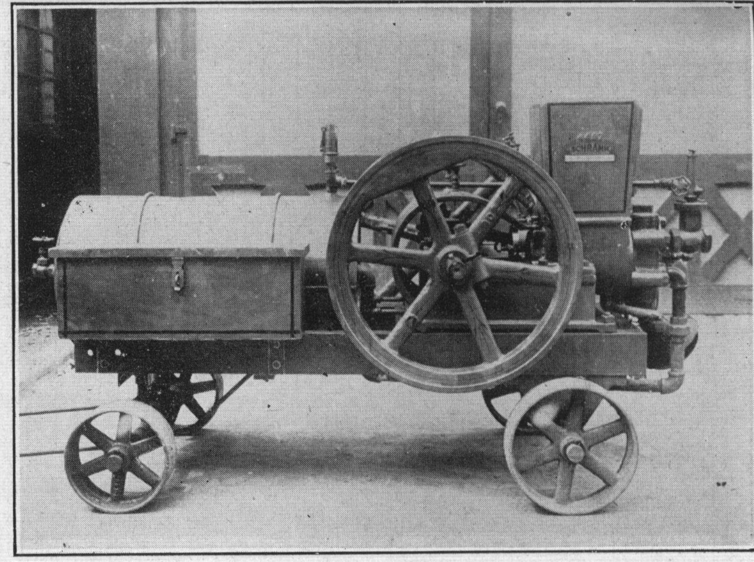
Sakai Filter Beds: Huge filter beds are constructed at Sakai village, where over half the water from the Muruyama-Sakai line flows to the filter beds through cast iron pipes and after filtration carried to the Wadabori service rsservoir through mortar lined steel pipes, designated as the Sakai-Wadabori line. The other half is delivered to the existing Daita aqueduct from the conduit of the Sakai-Wadabori line.

The total area of the Sakai filter beds is 23 acres to be divided into 20 sections, (of which, 12 are completed), filtering 100 cu. ft. per second. The filtering rate is 10-ft. in 24 hours, permitting three sections to be held in reserve or utilized for washing or other purposes.

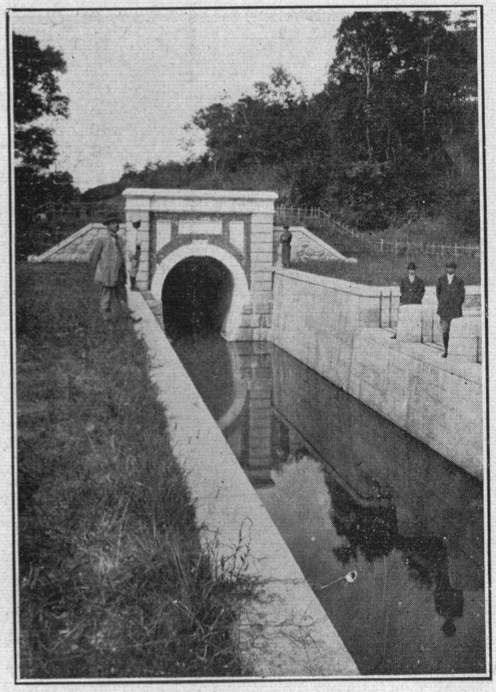
Sakai-Wadabori Line: The water from the Sakai filter beds is conveyed to the Wadabori service reservoir through a 6-ft. 3-in. mortar lined and concrete protected steel pipe and a concrete conduit, 6.7 miles long, at a flow in the pipes of 100 cu. ft. per second. The mortar lined steel pipes convey the clear filtered water to the Wadabori service reservoir and the



Waste Weir: Murayama-Sakai Line



Calking Machine



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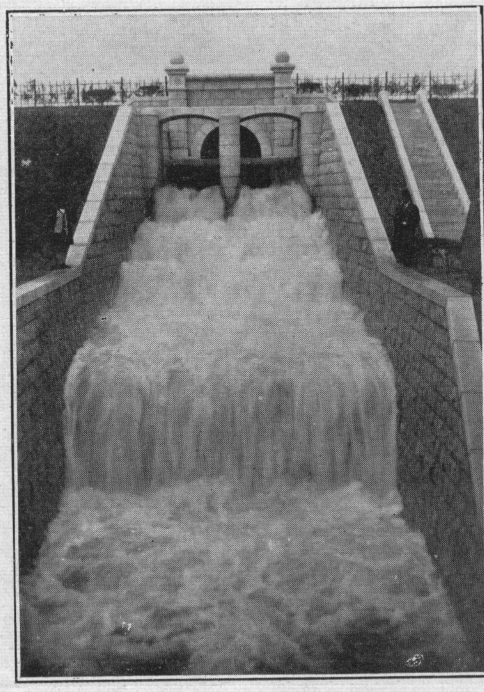
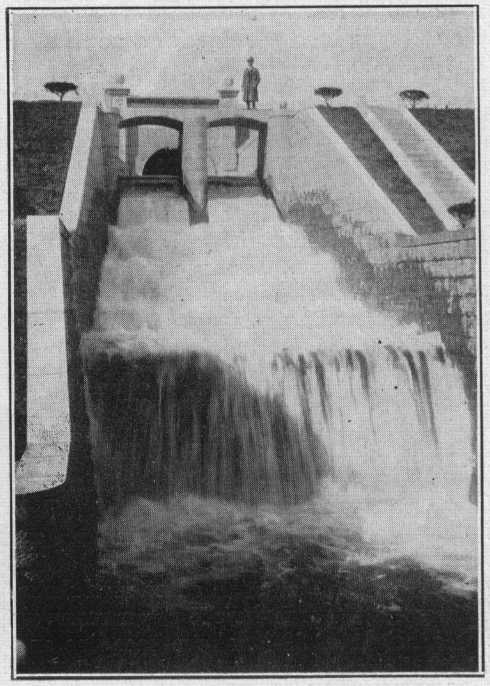
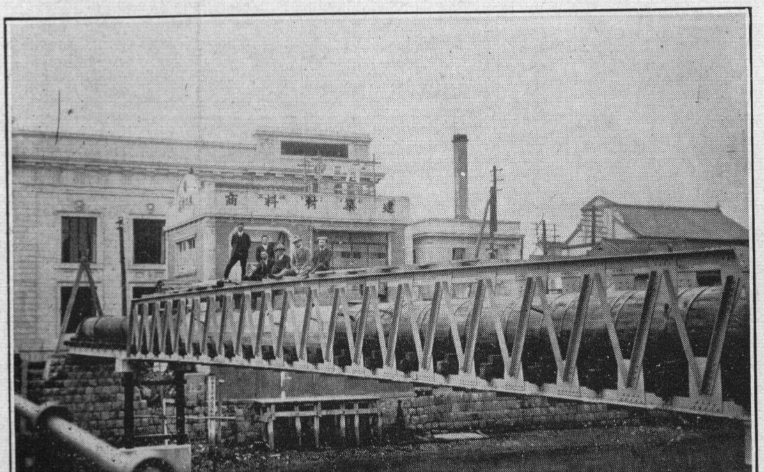


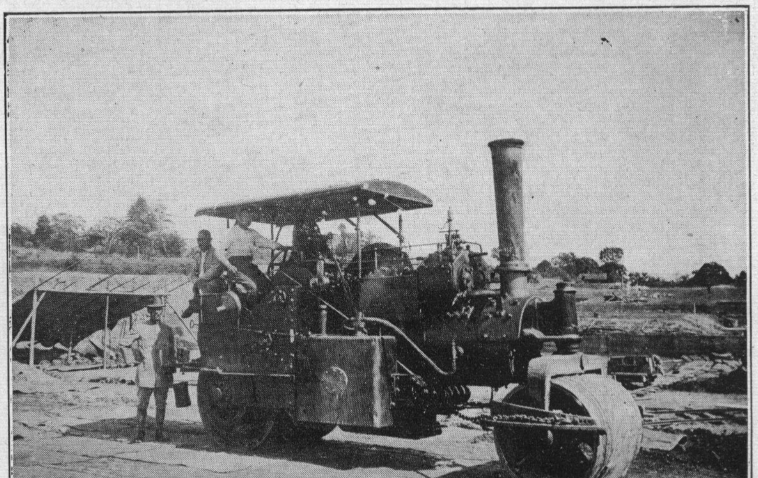


THE MURAYAMA-SAKAI LINE

Water Falls for Reducing Pressure



Bridge for Street Main



Steam Roller on Murayama Reservoir Dam

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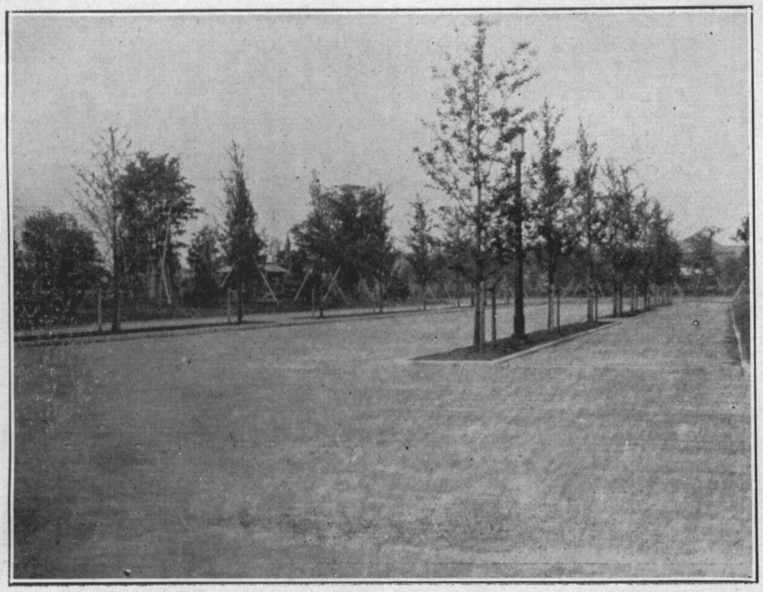


Road Paved with Sheet Asphalt on Block Base. Peers' School Entrance at Meiji Shrine. Laid December 1924 by Nippon Oil Co.'s Road Department.

Asphalt Sidewalks and Street at Entrance to Peers' Girls' School, Meiji Shrine Outer Garden. Laid December 1924 by the Nippon Oil Co.'s Road Department.

Notable among these large Japanese companies who have entered the paving field is the Nippon Oil Company. After careful study on the part of their engineers who had been sent to America, the Nippon Oil Co. made negotiations for the exclusive rights to the patents owned by Warren Brothers Company of Boston, Mass., the largest paving concern in the world. Under this arrangement the Nippon Oil Company is in a position to receive from Warren Brothers all technical advice and such assistance as may be required in the laying of Warrenite-Bitulithic and all other types of asphaltic pavement. The value of such a connection should do much toward securing first quality pavements in Tokyo and the Nippon Oil Company has organized and developed a road department capable of completing with dispatch the largest contracts for asphalt pavement. Toward this end the largest and most modern equipment has been imported, capable of doing things on a big scale; a paving laboratory has been installed in Tokyo capable of testing all paving materials as well as regulating the quality of the work done from day to day. To assist in the organization, and as technical advisers to its road department, the Nippon Oil Company has engaged the services of two expert American engineers trained in the asphalt paving business with the Warren Brothers Company.

To date, the Nippon Oil Company road department has received contracts for paving work in various parts of Japan, the most noteworthy contract being the paving of the Meiji Shrine outer gardens. This is to be paved with Warrenite-Bitulithic, using Japanese asphalt. The contract covers approximately two miles of wide street and four miles of asphalt side-walks, the largest single contract for paving ever let in Japan.

The Tokyo authorities have already laid large areas of pavement of many various kinds, but the final choice as the standard type of pavement for the city will undoubtedly be asphalt. Several varieties of asphalt have been tried in which the Japanese product has stood the tests. The asphalt produced by the Nippon Oil Company from Japanese crude oil has passed the most rigid tests for quality and has been found as satisfactory as the imported products. It is produced in large quantities and will help to make it possible for Tokyo to build first quality streets at a comparatively low cost. The adoption of asphalt as the standard type of pavement for Tokyo is economically a sound policy because all material that enters into the construction of an asphalt street is produced from crude products found in Japan. Nothing need be imported in the construction of asphalt pavements except machinery, which will, sooner or later, also be manufactured in Japan.

Already there are large areas of asphalt pavement laid in Tokyo, and that the plans for the future call for a great deal more of that material is a wise decision from an engineering and an economic point of view. The Japanese are asking why Tokyo should import wood for wood blocks or foreign asphalt when there is produced in Japan asphalt that compares favorably with the best asphalt in the world.

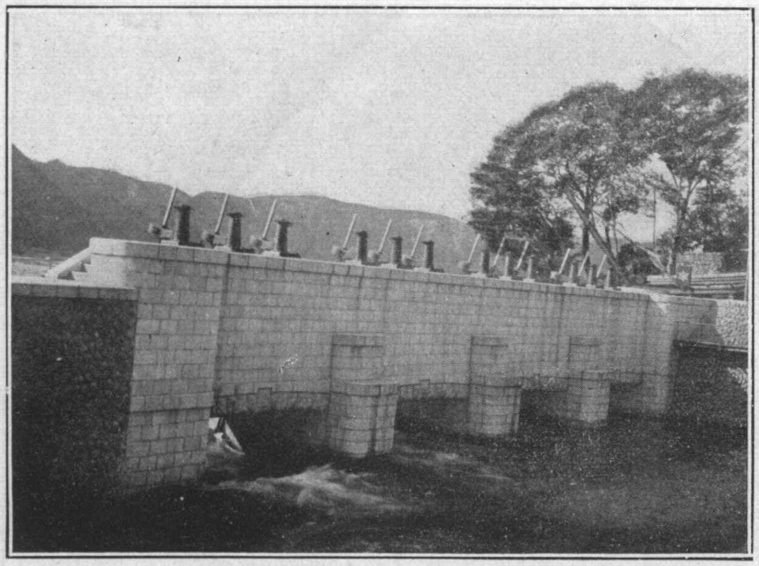
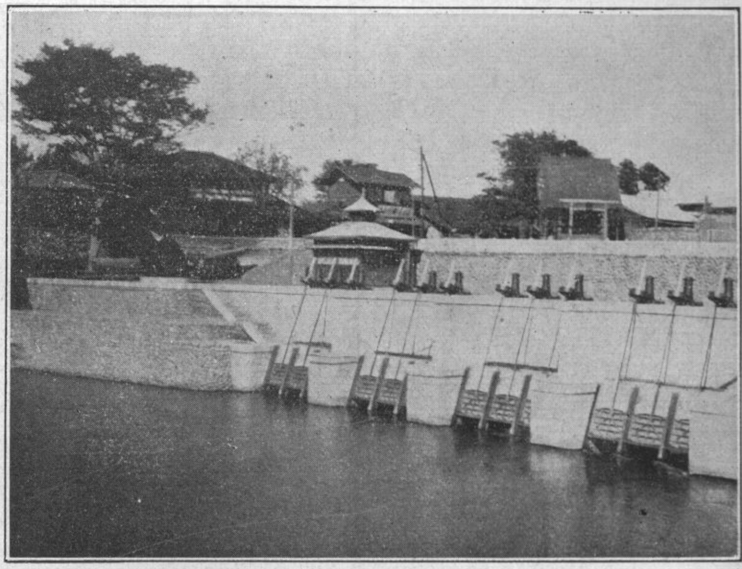
Asphalt Sidewalk, Meiji Shrine Outer Garden. Laid April 1925 by Nippon Oil Co.'s Road Department.

Powerful Radio Transmitter for Japan

THE radio transmitter ordered from the International General Electric Company by the Japanese Government dwarfs the usual powerful radio station familiar to the broadcast listener. The set, ordered through Mitsui & Co., puts 80 kilowatts of energy into the antenna—the majority of American broadcasting stations use one-half or one kilowatt, and the most powerful use only five kilowatts.

This vacuum tube transmitter is not intended for broadcasting, however, but for telegraphic communication between naval stations of Japan. It operates between frequencies of 15,000 and 43,000 cycles, with maximum efficiency at 24,000 cycles, or on a wave length of 12,500 meters. It will be possible to send upward to 100 words per minute, and the keying may be done at a point remote from the transmitter.

An 80 kilowatt vacuum tube transmitter is as powerful as a 300 k.w. arc transmitter, is more economical in operation costs, easier to use, and does not produce the "mushing" of arc sets which interferes so much with broadcast programs.

Intake at Hamura

The Tokyo Municipal Water Works

By Motoki Ono, Chief Engineer, Tokyo Water Works Department

THE water supply system of the City of Tokyo dates back to July 1590, when, on his entry into Yedo, the Shogun Iyeyasu commanded Tadayuki Okubo to devise a plan to provide the town with service water. In 1654, the Tokugawa government completed the cutting of an aqueduct 25 miles long to conduct the water of the river Tama to the capital. With certain modifications this ancient water supply is still utilized for the needs of the present day metropolis, engineering science having transformed the old open cut canal into a modern supply line, with mpounding and service reservoirs, filter beds, regulating stations and other refinements invented for the better protection of the public health.

The present water works system was originally designed by the Tokyo Street Improvement Commission with the assistance of Mr. William Kinmond Berton, adviser to the Home department, Major General H. S. Palmer of the British Army and Mr. H. Gill, then director of the Berlin Water Works.

The main source of supply is the Tama River and its tributaries, the intake being located at the village of Hamura and conducted to the Yodabashi reservoir and purifying plant on the outskirts of Tokyo. Along the twenty-five miles of canal mains there are eight stations for inspecting and regulating the flow of water. The Yodobashi purifying plant consists of four receiving and settling basins having a total capacity of 11,928,429 cu. ft., twenty four filter beds covering an area of 21 acres; a service reservoir and a pumping station.

The Yodobashi works is also equipped with sand washing apparatus, a coagulating plant and special railway facilities for coal delivery, etc. Construction was commenced in December 1892 and partially completed in January 1899, when the first water was turned into the distribution pipes. The revenue collected by the Water Works Bureau in 1922 was approximately £421,410.

One third of the filtered water from Yodobashi flows directly into the service reservoir and distributed to the higher districts of the city by six sets of steam plunger pumps. The other two-thirds flows by gravity into two service reservoir, one at Hongo and the other at Shiba, thence through the distributing pipes to the lower districts of the city.

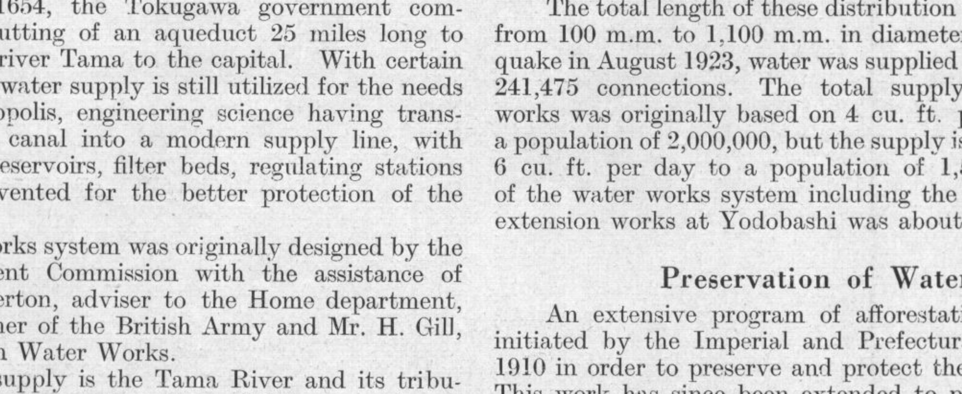
The total length of these distribution pipes is 517 miles, varying from 100 m.m. to 1,100 m.m. in diameter. Just before the earthquake in August 1923, water was supplied to 390,784 houses through 241,475 connections. The total supply capacity of the water works was originally based on 4 cu. ft. per capita per day for a population of 2,000,000, but the supply is now calculated to furnish 6 cu. ft. per day to a population of 1,500,000. The total cost of the water works system including the construction of the small extension works at Yodobashi was about £1,000,000.

Preservation of Water Sources

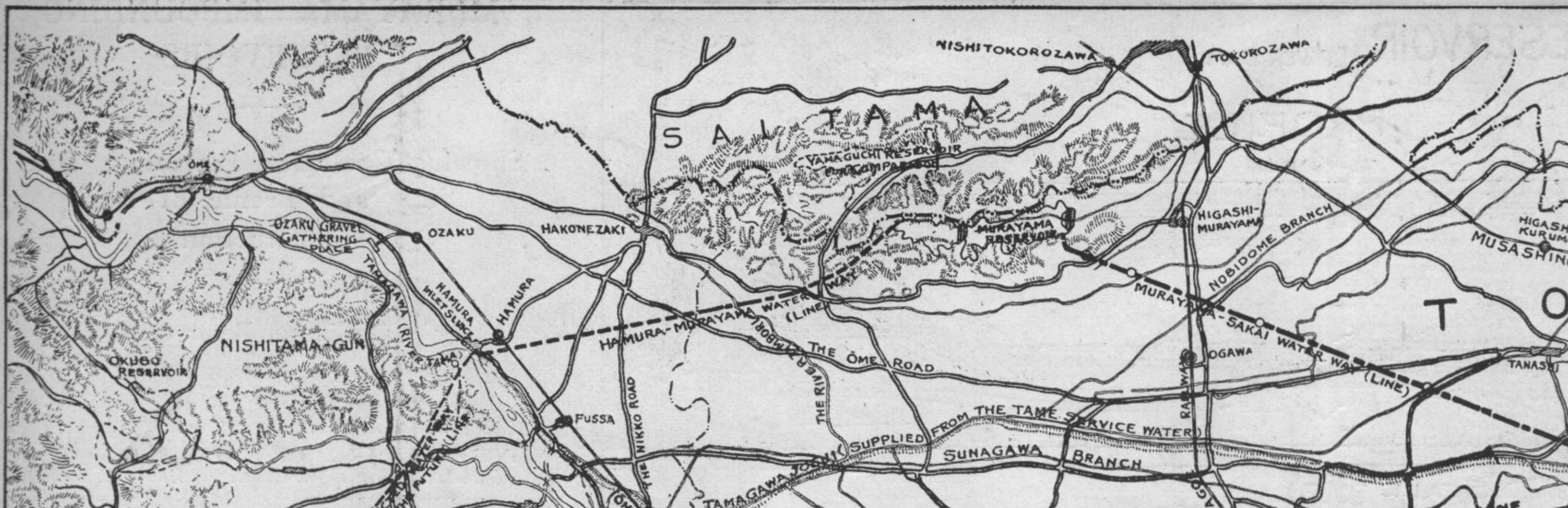
An extensive program of afforestation of public lands was initiated by the Imperial and Prefectural authorities in October, 1910 in order to preserve and protect the Tama River water shed. This work has since been extended to private lands in Kitatsuru and Yamanashi counties, and at present, the Water Works Board owns nearly 40,000 acres of forests in addition to sharing in the profits from several hundred acres of private forests planted in accordance with the forestry regulations.

Extension Plans

For the extension and improvement of the original water works scheme, new plans involving and expenditure of approximately £5,400,000 were drawn up by the Street Improvement Committee in December, 1911 and approved by the Home Minister in September, 1912. Although the war and the earthquake operated to delay the work, about eighty per cent. of the program has since been completed. The new extension scheme derives its water supply from the Tama River, with the intake not far from that of the original system. The water is to be stored in two



The River Tama at the Intake at Hamura



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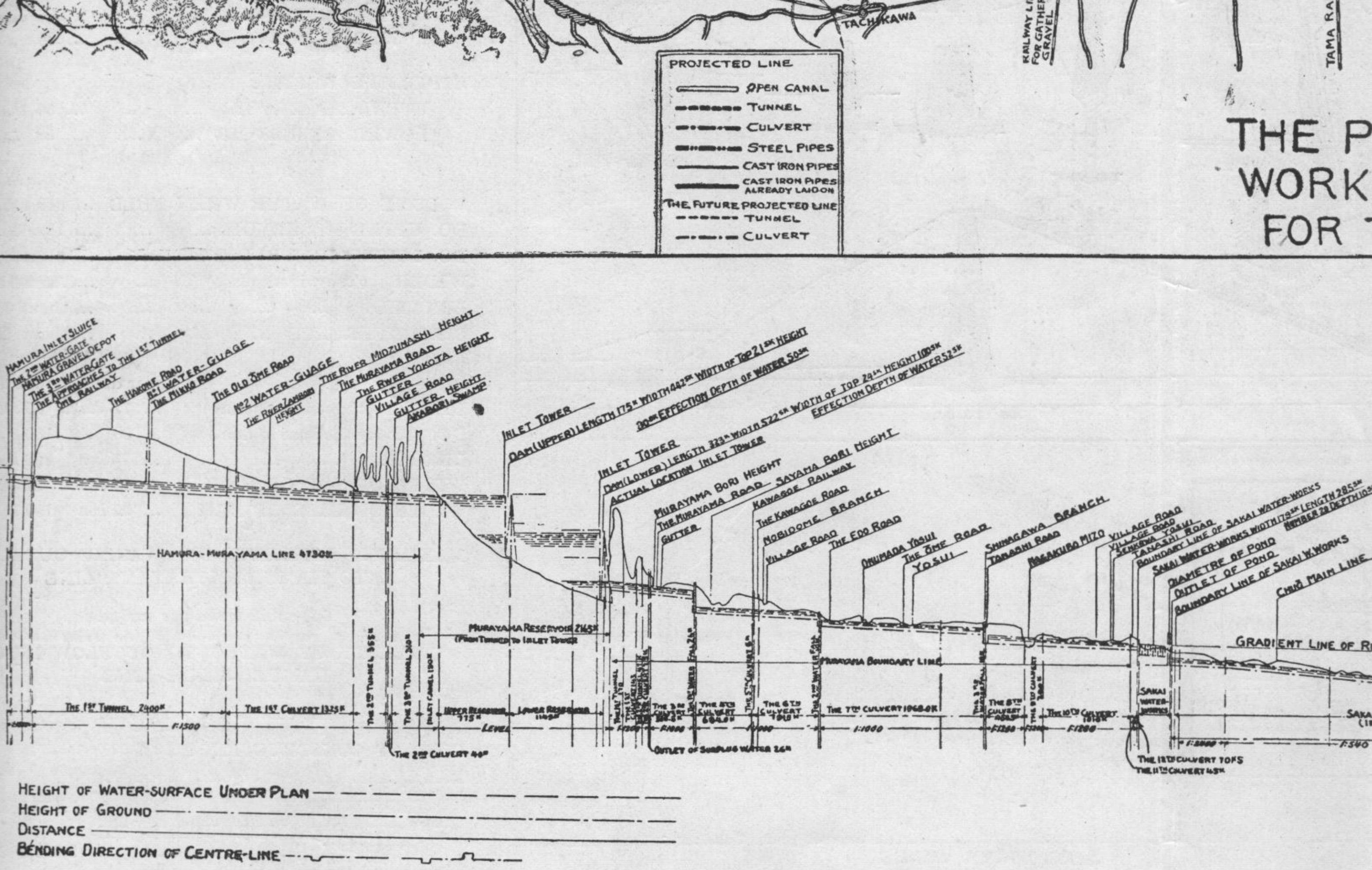
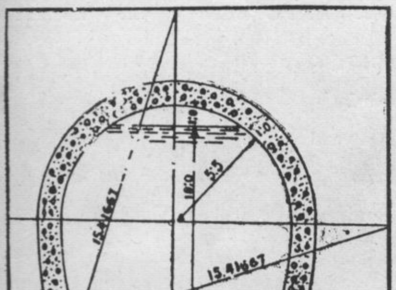
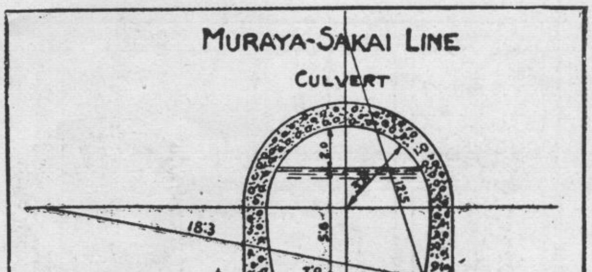
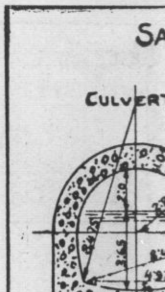


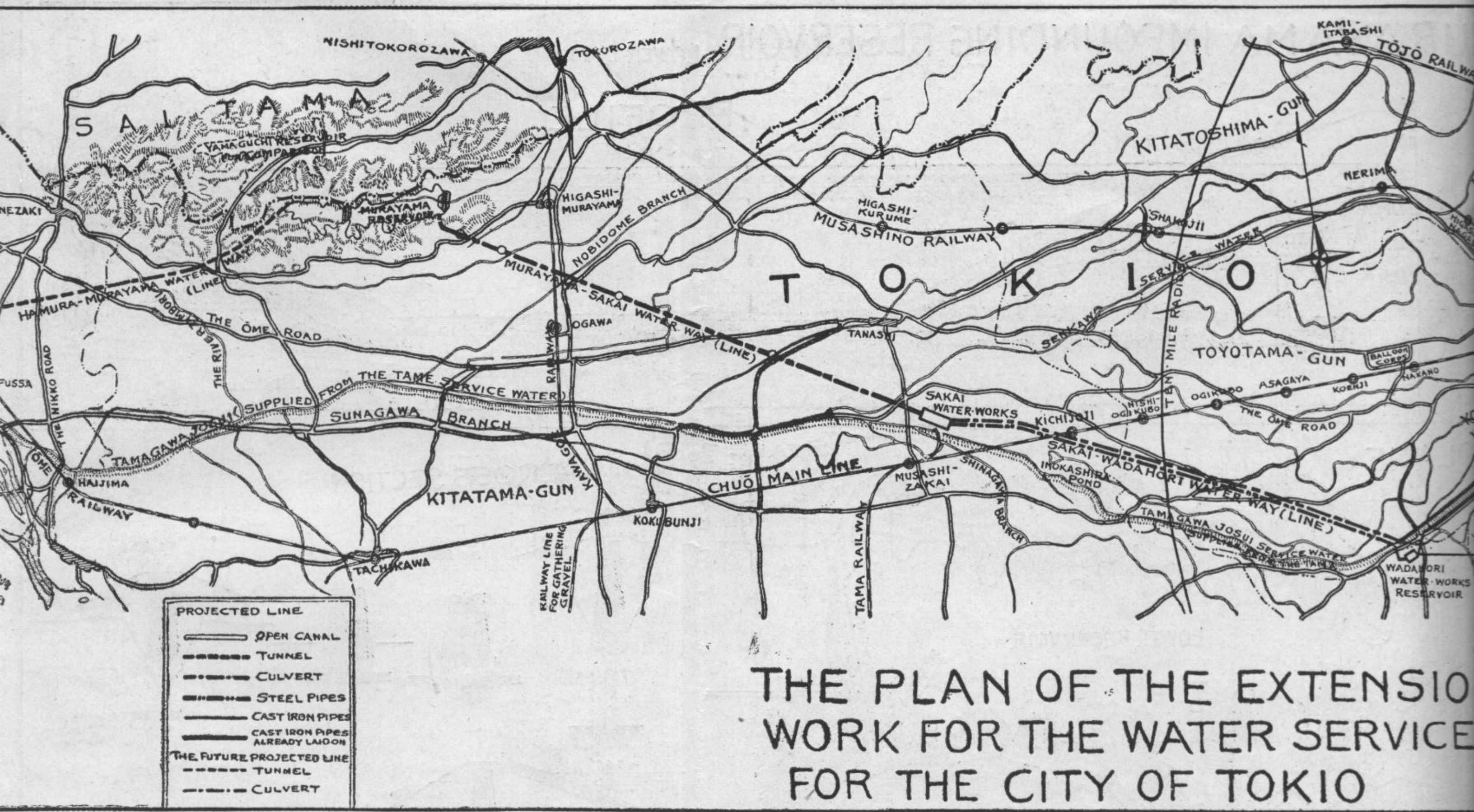


Hamura-Murayama Line.

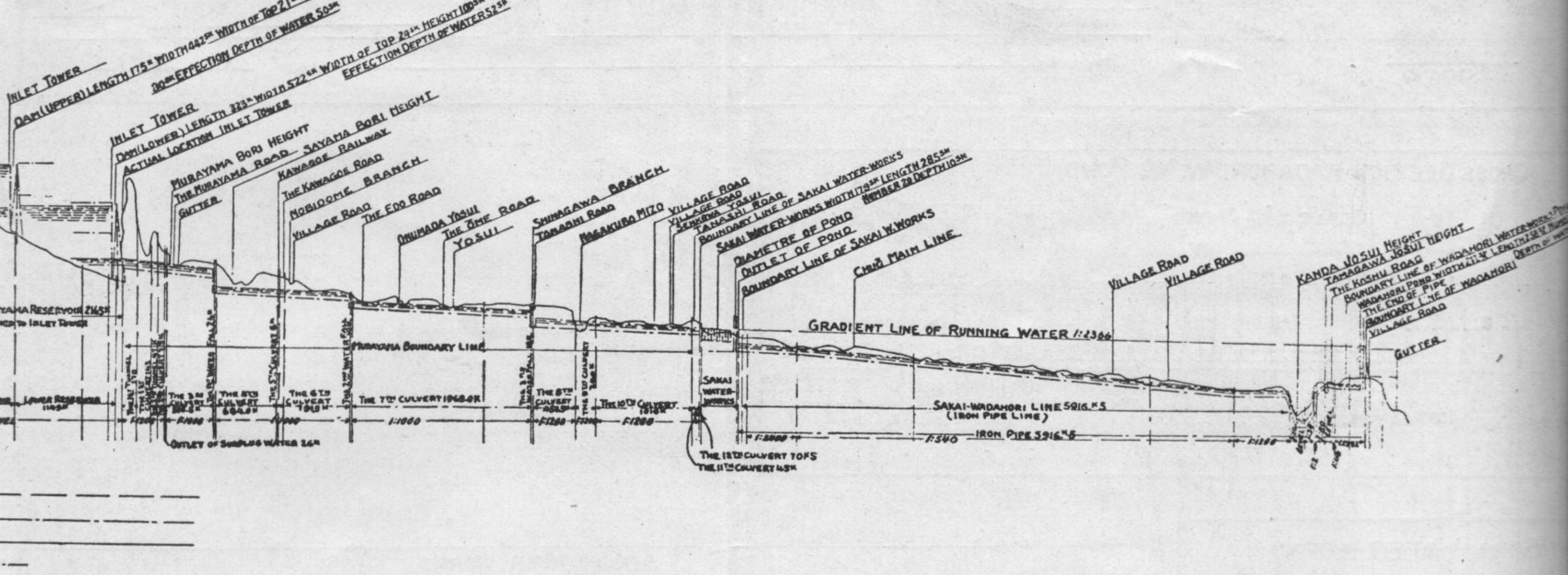
Tunnel.
Left







THE PLAN OF THE EXTENSIO
WORK FOR THE WATER SERVICE
FOR THE CITY OF TOKIO



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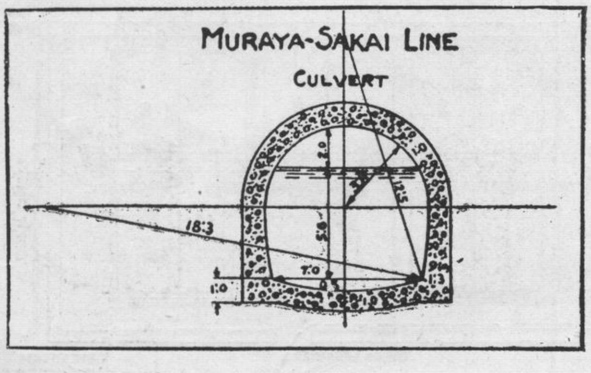
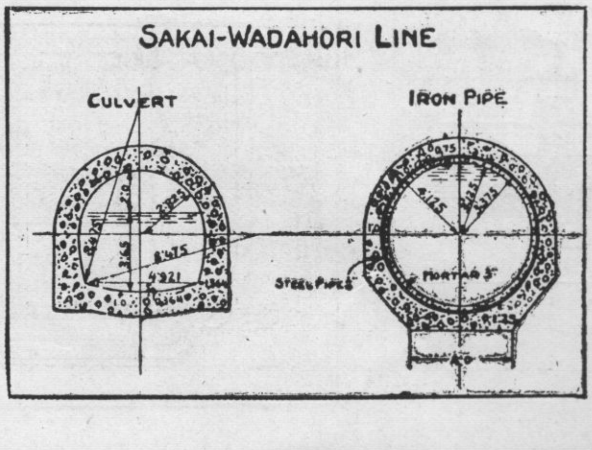
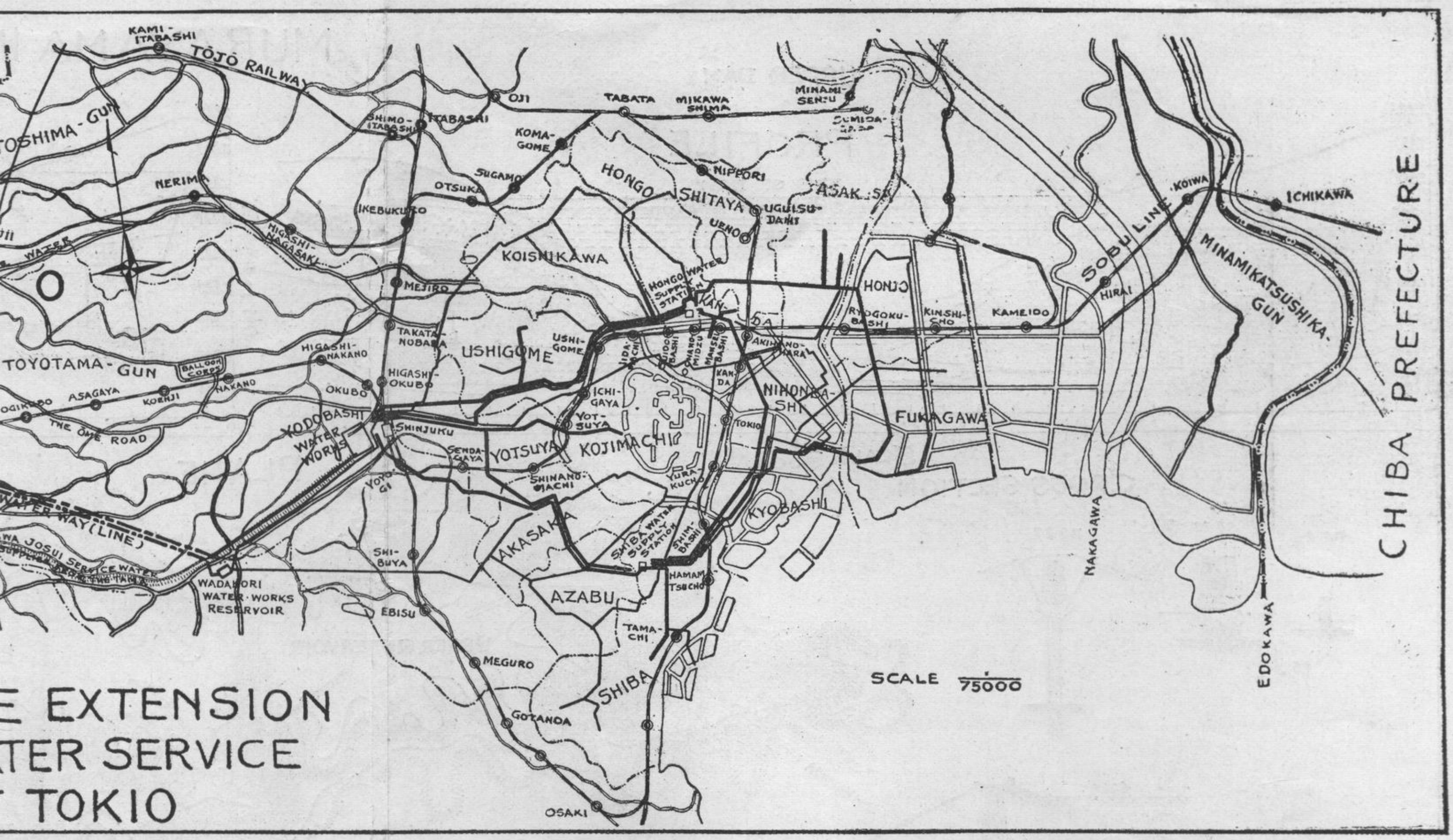
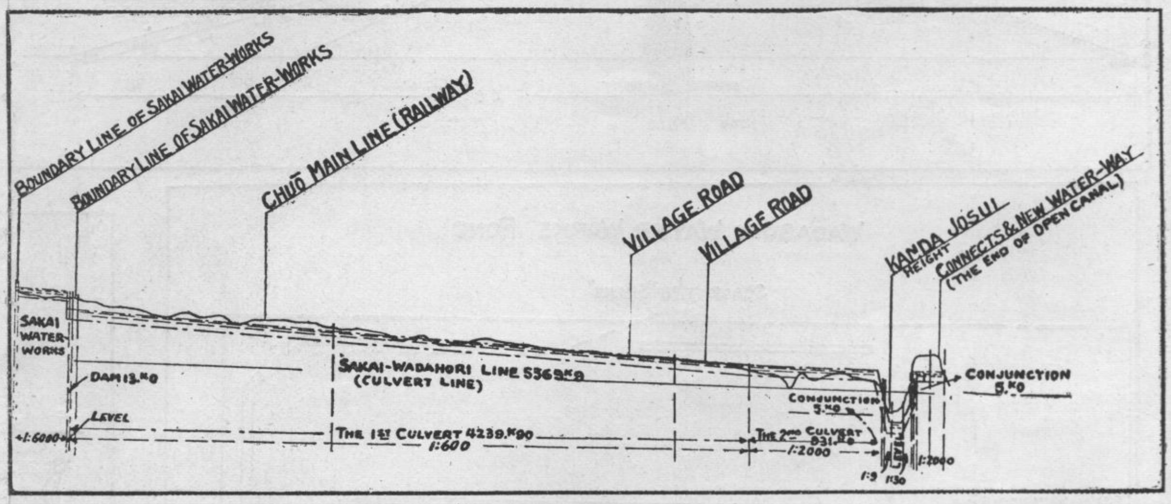
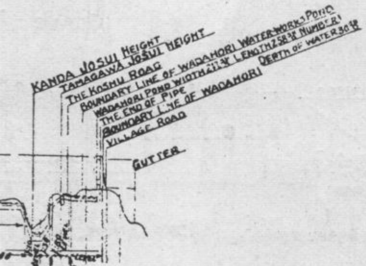










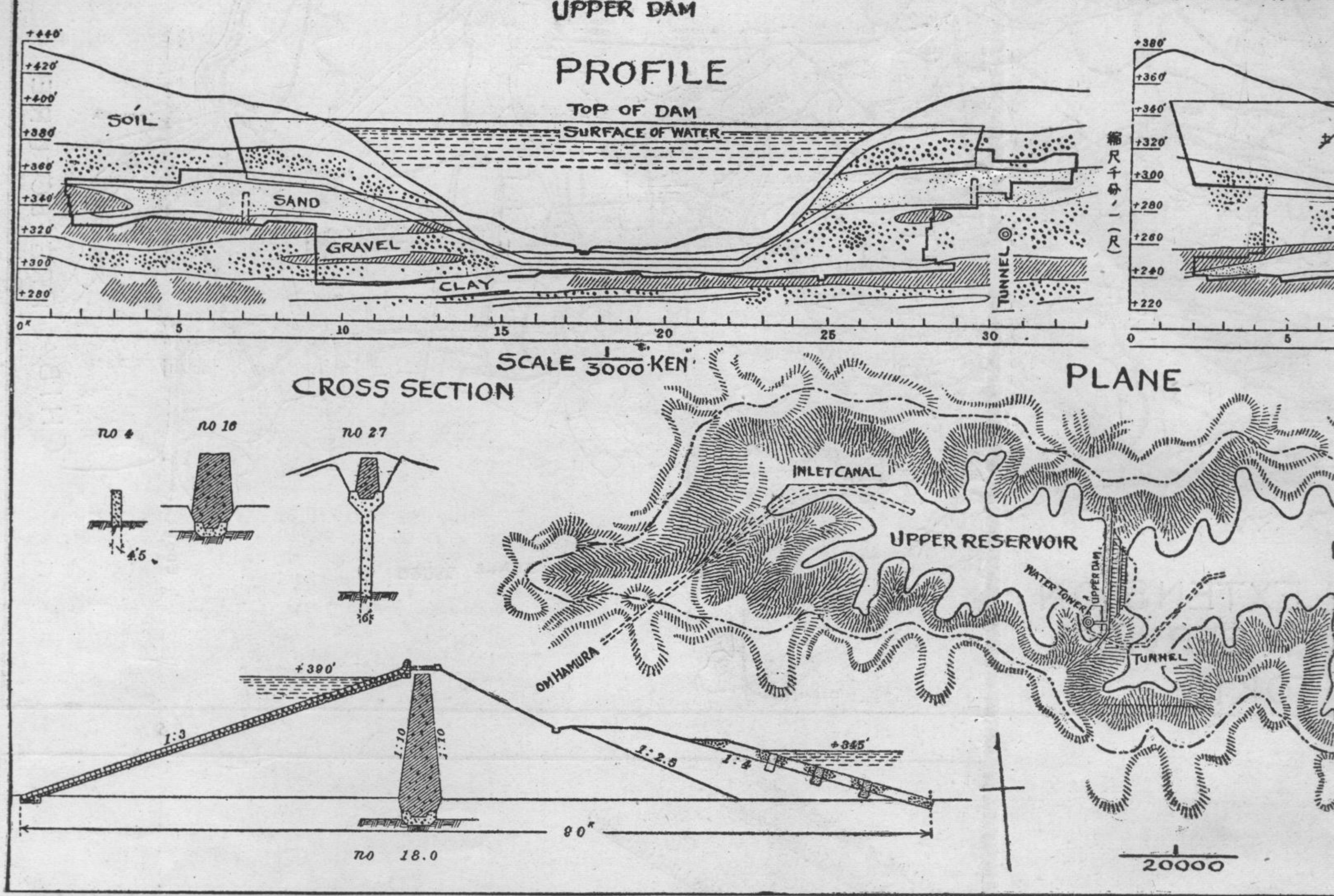
PLANS OF THE TOKYO MUNICIPAL WATER WORKS SYSTEM

Reconstruction Number of

THE FAR EASTERN REVIEW

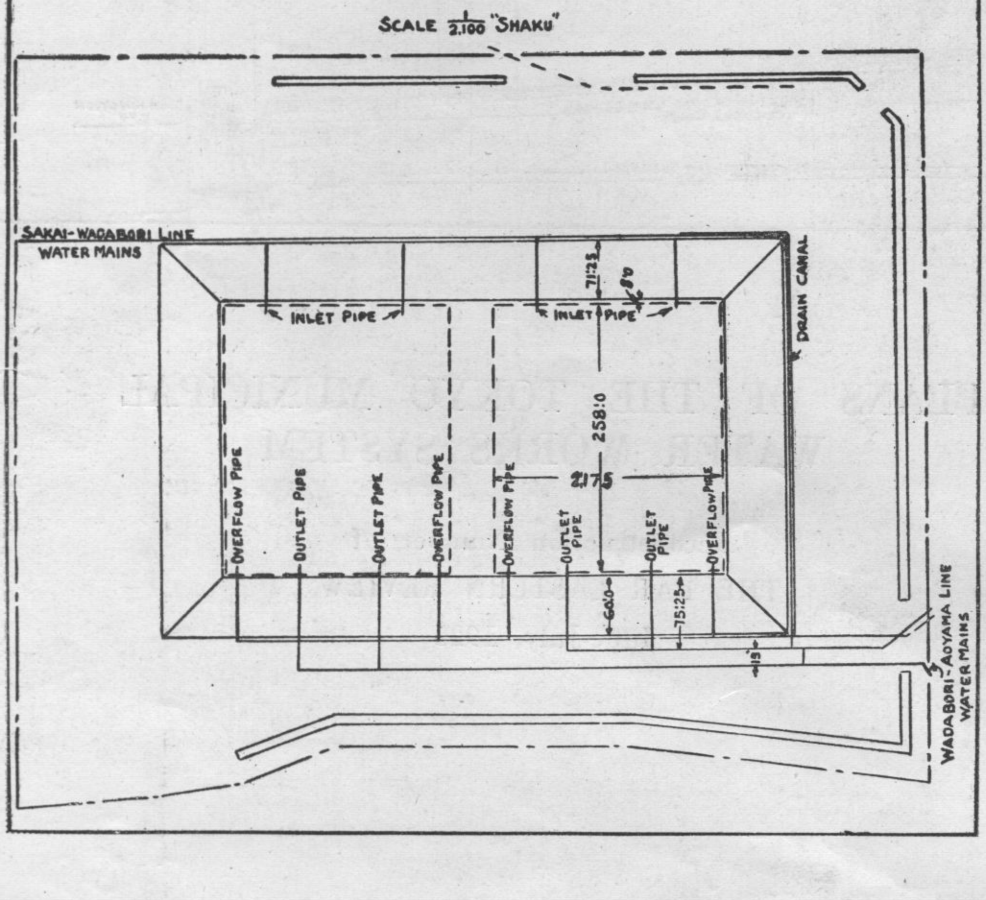
June-July, 1925

MURAYAMA I



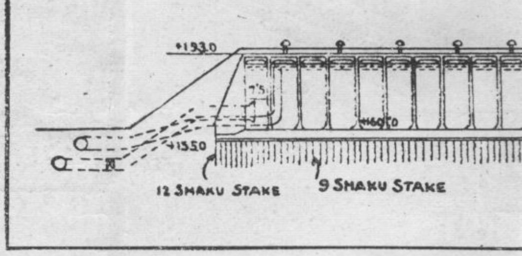
WADABORI WATER WORKS POND

SCALE 1/2,100 "SHAKU"



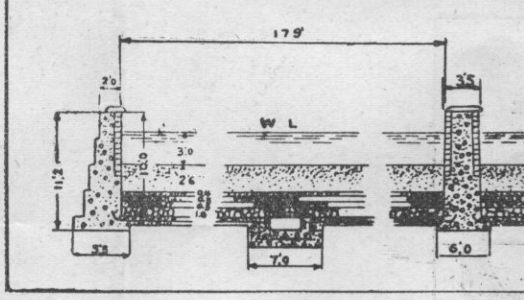
CROSS SECTION WADA

SCALE



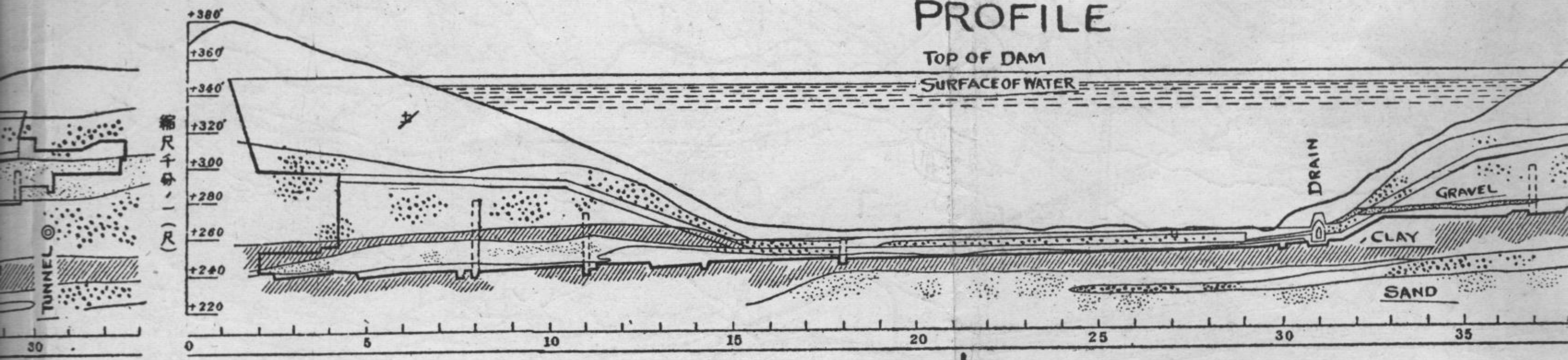
CROSS SECTION SAKAI WATER WORKS

SCALE 1/2,000 "SHAKU"



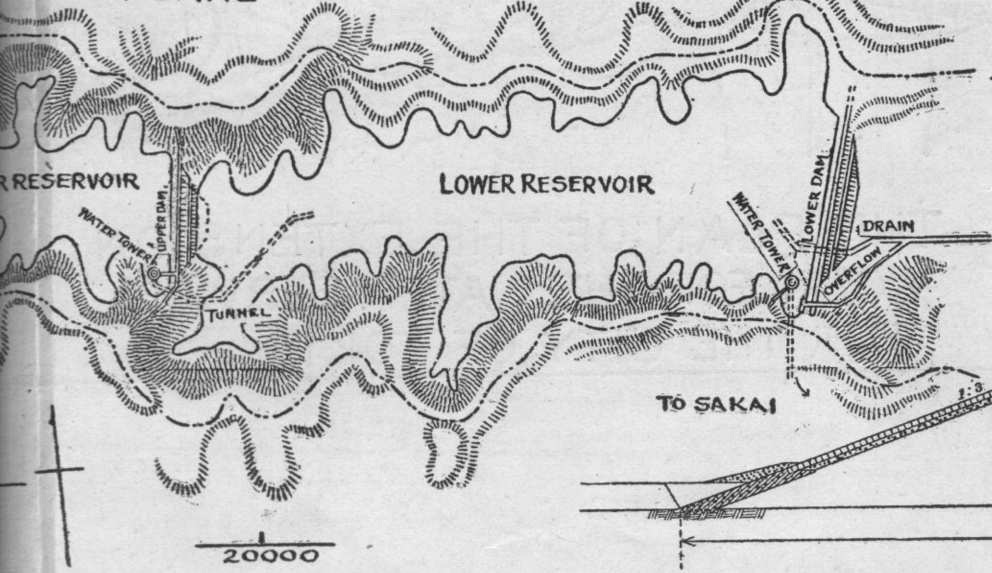
MURAYAMA IMPOUNDING RESERVOIR LOWER DAM

PROFILE

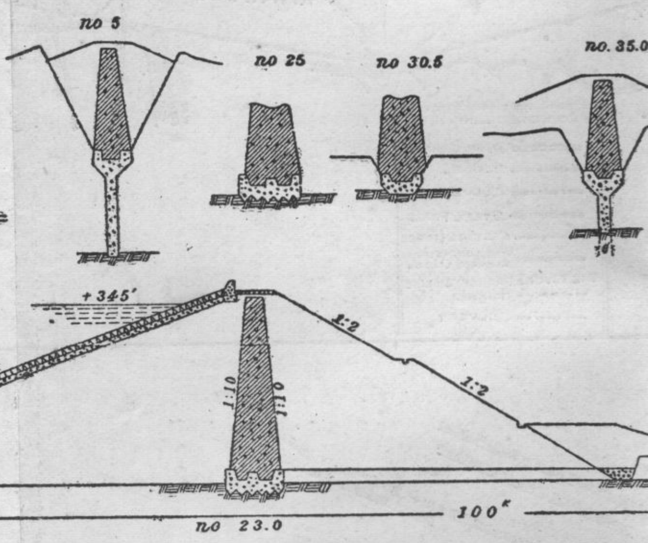


SCALE $\frac{1}{3000}$

PLANE

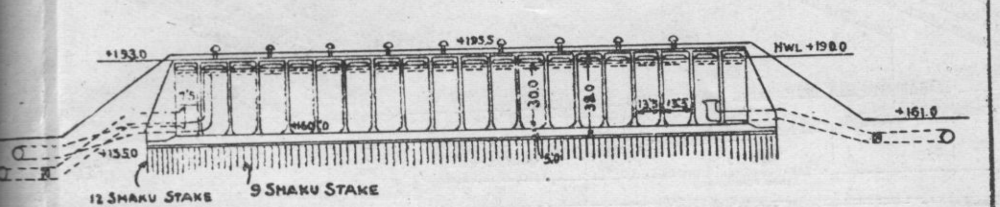


CROSS SECTION



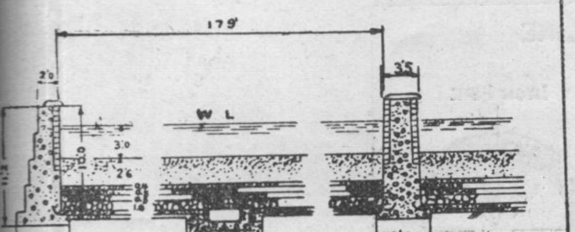
CROSS SECTION WADABORI W. W. POND

SCALE $\frac{1}{1,000}$ "SHAKU"



CROSS SECTION SAKAI WATER WORKS

SCALE $\frac{1}{2,000}$ "SHAKU"



SAKAI WATER WORKS

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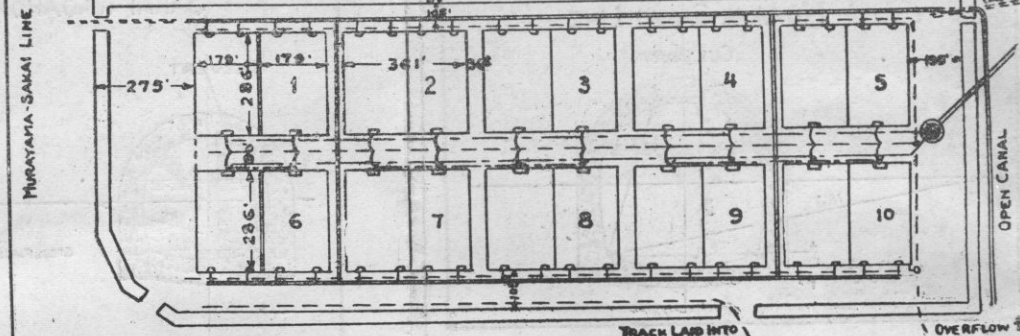
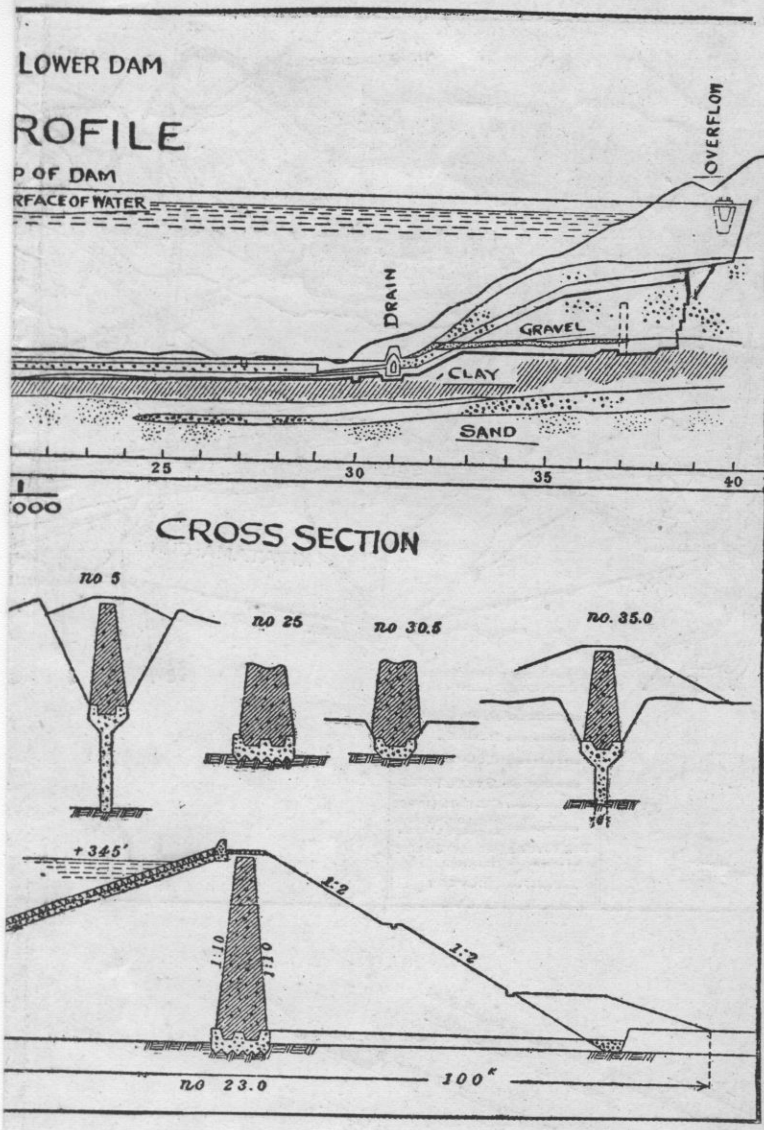
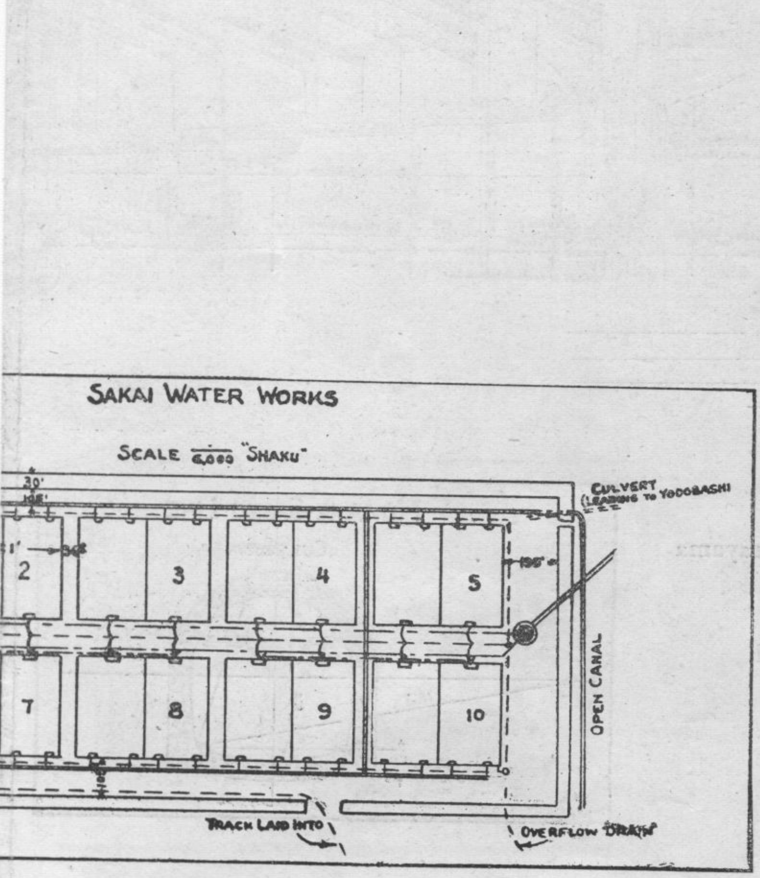






MURAYAMA IMPOUNDING RESERVOIRS

Showing Geological Formation, Dam Sites and Profile of Dam Construction

Outline of Reservoir

	Tsubo (in Area)
BASIN	1,100,000
SUPERFICIAL AREA OF WATER WHEN FULL	482,000
DO. UPPER RESERVOIR	138,000
DO. LOWER RESERVOIR	344,000

DEPTH OF WATER WHEN FULL:

UPPER RESERVOIR	66 *shaku*
LOWER RESERVOIR	80 ,,

EFFECTIVE DEPTH:

UPPER RESERVOIR	50 *shaku*
LOWER RESERVOIR	62 ,,

	Cubic *Shaku*
VOLUME OF WATER WHEN FULL ...	648,450,000
DO. UPPER RESERVOIR	138,000,000
DO. LOWER RESERVOIR...	510,450,000
WIDTH (at the widest place)	About 11 *cho*
LENGTH	About 40 ,,
CIRCUMFERENCE	About 2 *ri* and 25 *cho*

	Upper dam.	Lower dam.
HEIGHT (above the Bottom) ...	71 *shaku*	85 *shaku*
DO. (Above the base of dam) ...	80 ,,	100 ,,
LENGTH	175 *ken*	323 *ken*
WIDTH OF TOP OF DAM ...	21 *shaku*	24 *shaku*
WIDTH OF BASE OF DAM ...	90 *ken*	100 *ken*

MAXIMUM CAPACITY OF WATER OUTFLOW INTO HAMURA-MURAYAMA LINE

600 cubic *shaku* per second

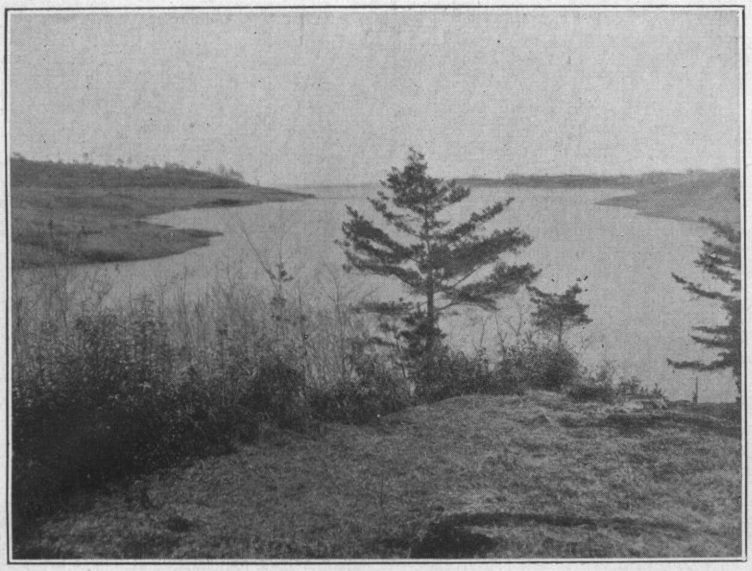
CAPACITY OF WATER TO OUTFLOW INTO HAMURA-SAKAI LINE

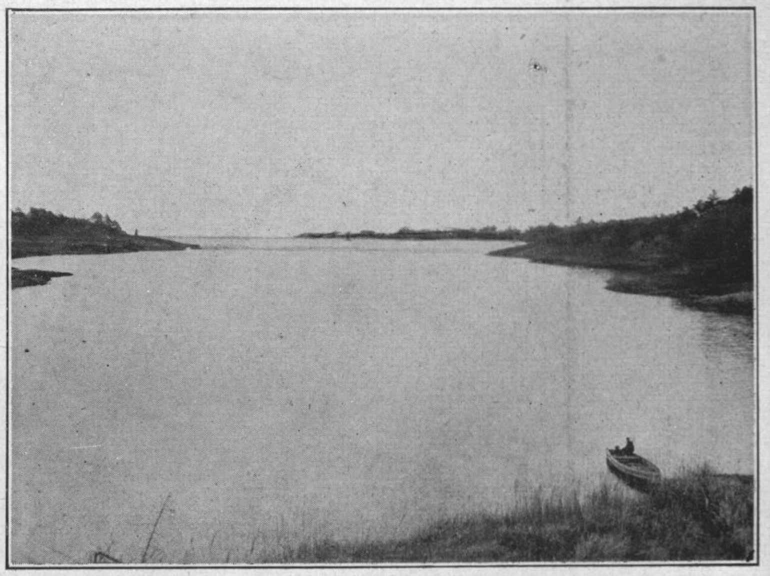
250 cubic *shaku* per second

COST OF CONSTRUCTION:

	Yen
EXPENDITURES FOR MURAYAMA RESERVOIR	7,457,993,000
EXPENDITURES FOR UPPER RESERVOIR	2,891,837,000
EXPENDITURES FOR LOWER RESERVOIR	4,359,834,000
MISCELLANEOUS EXPENSES ...	206,322,000

SHAKU = 0.994-ft.
KEN = 6 *shaku*
CHO = 1,200 yard
RI = 36 *cho*
TSUBO = A land measure of 6 *shaku* square.





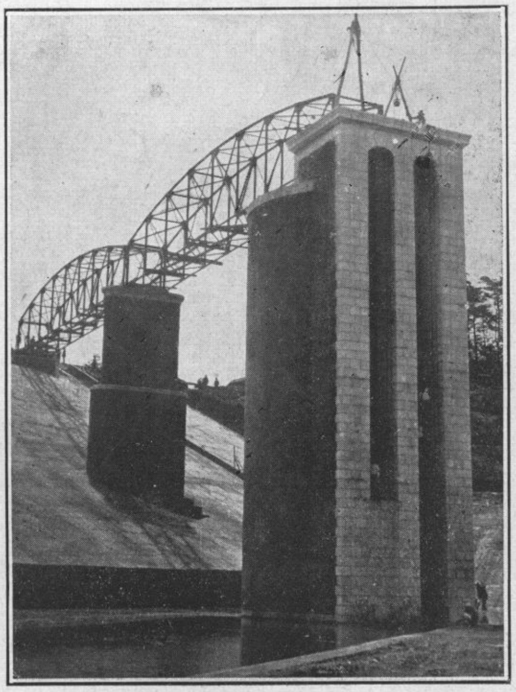
The Murayama Higher Reservoir

impounding reservoirs capable of delivering 6 cu. ft. per head per day for a population of 1,500,000.

General Description

Hamura-Murayama Line : From the intake at Hamura, an open canal, conduit and tunnel capable of conducting 600 cu. ft. per second will pass through the villages of Fussa, Kumagawa, Sunagawa and Nakato and discharge into the Muruyama impounding reservoirs. The length of this line is about 5.4 miles, the open canal having a gradient of 1,-1,000 with a depth of four feet and the conduit and tunnel a gradient of 1,-1,500 with a depth of 10-ft.

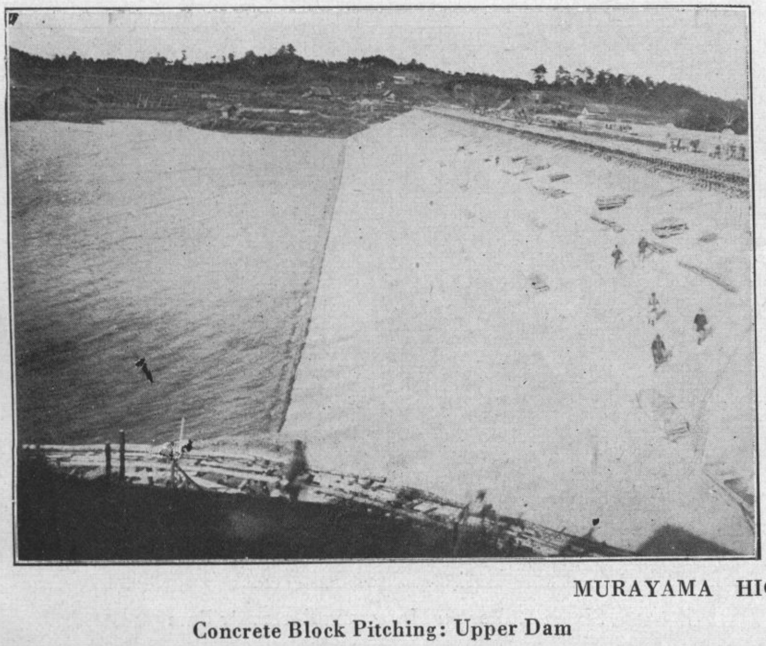
Muruyama Impounding Reservoir : The two reservoirs at Muruyama, designated as the upper and lower, are formed by means of two earthen dams, one at Imokubo and the other at Yakebe. The protecting dam for the upper reservoir has a height of 80-ft. above base line and 71-ft. above the reservoir bed. Its length is 1,050-ft. with a top width of 21-ft. Near the southern extremity of the dam where the reservoir forms a bay, an outlet tower has been erected. From the inside of the tower the water flows through a tunnel to the lower reservoir. A spillway near the outlet tower permits the overflow from the upper reservoir to pass to the lower reservoir by means of conduits and tunnels.

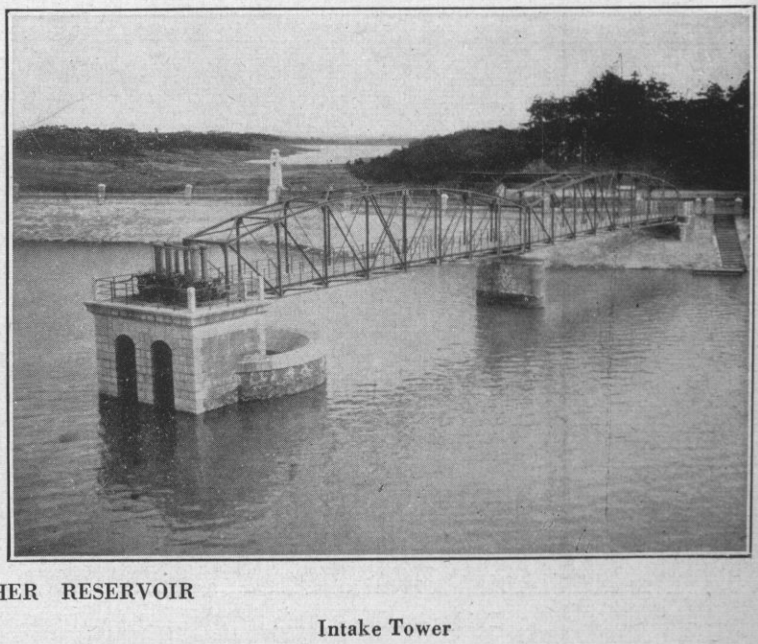


Intake Tower: Higher Murayama Reservoir

The maximum capacity of the lower reservoir is 510,000,000 cu. ft. The height of the dam above base line is 100-ft. and 85-ft. above the bed, with a length of 1,928-ft. and a top width of 24-ft. An outlet tower is erected in a bay at the southern end of the reservoir near the dam through which the water flows into the Muruyama-Sakai conduit. Near this tower is a waste weir or gate through which the overflow of the lower reservoir above high water level is conducted by an conduit, open canal and pipes to the Muruyama River.

Muruyama-Sakai Line : The tunnels and conduits between the Muruyama impounding reservoirs and the Sakai filter beds, designated as the Muruyama-Sakai line, pass through the villages of Shimizu,

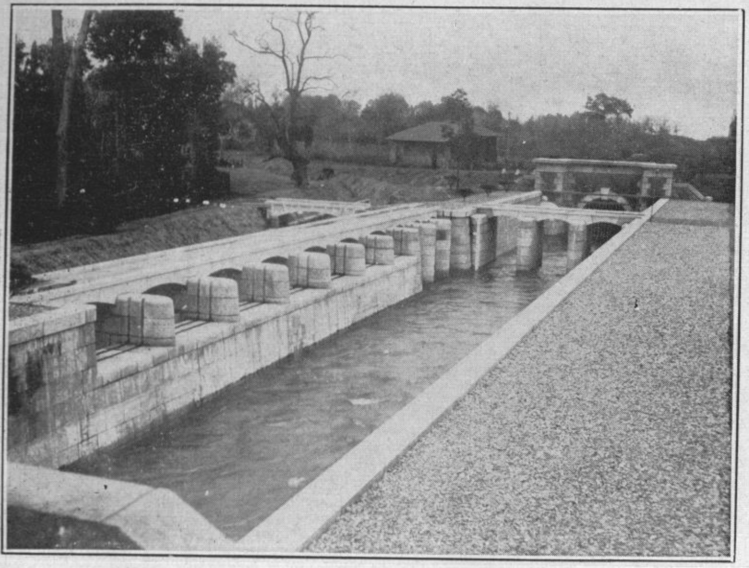




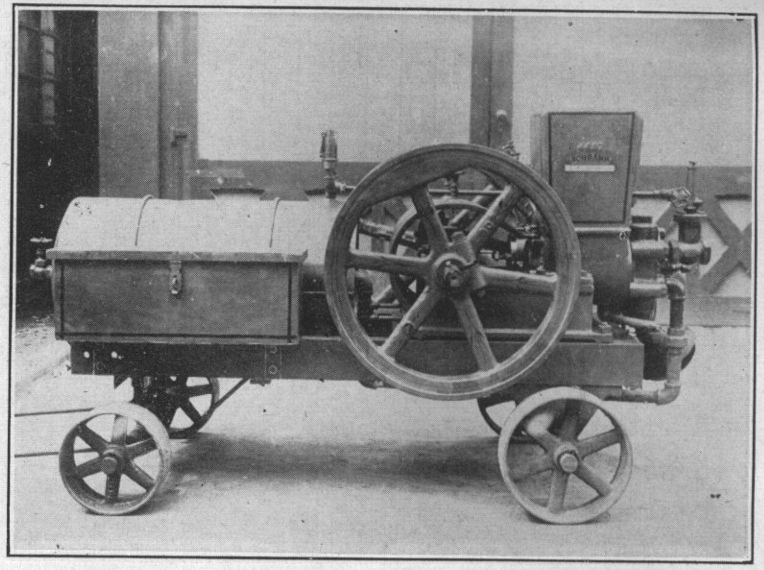
MURAYAMA HIGHER RESERVOIR

Concrete Block Pitching: Upper Dam

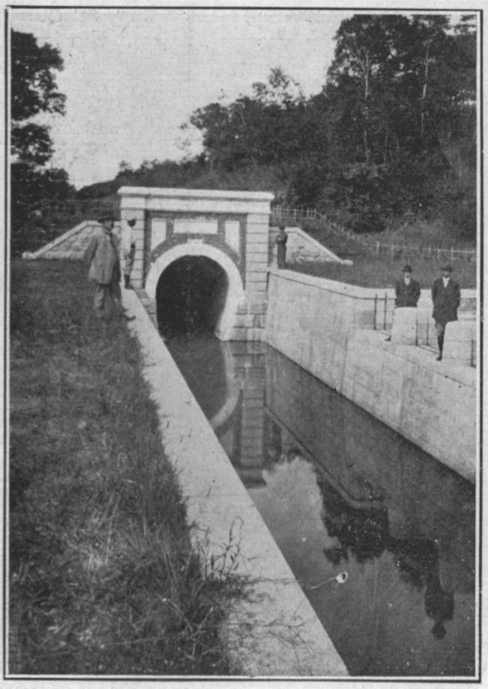
Intake Tower

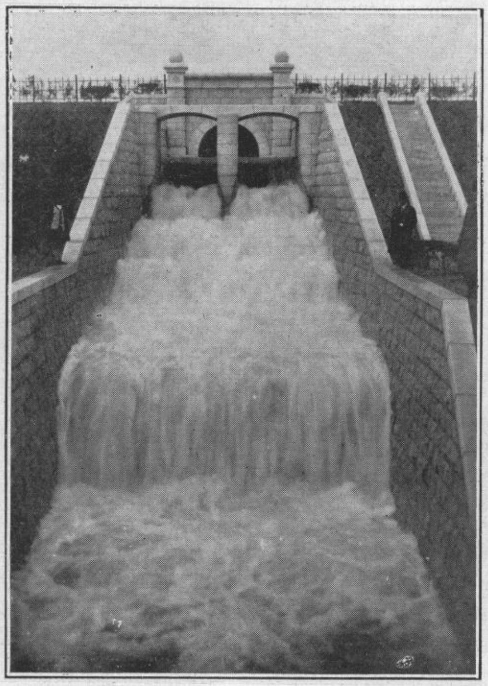


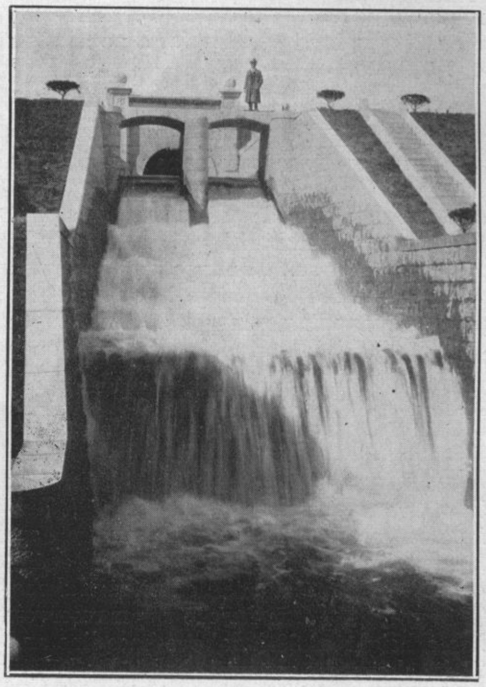
Waste Weir: Murayama-Sakai Line



Calking Machine



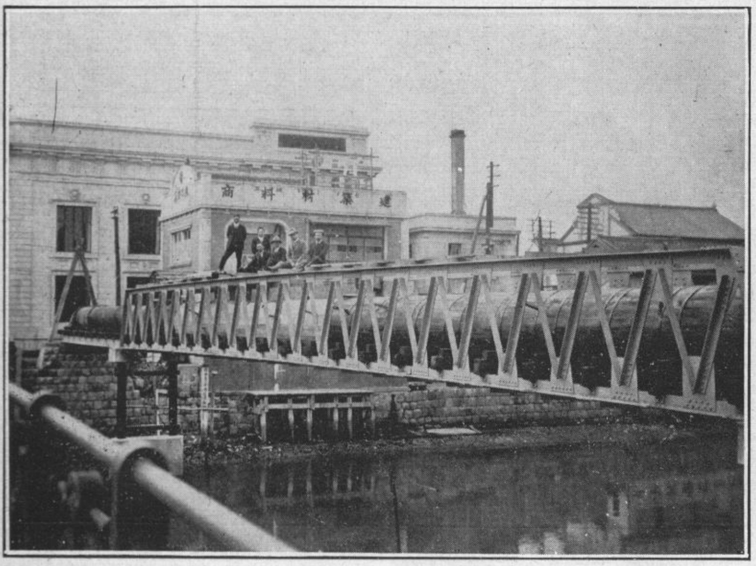




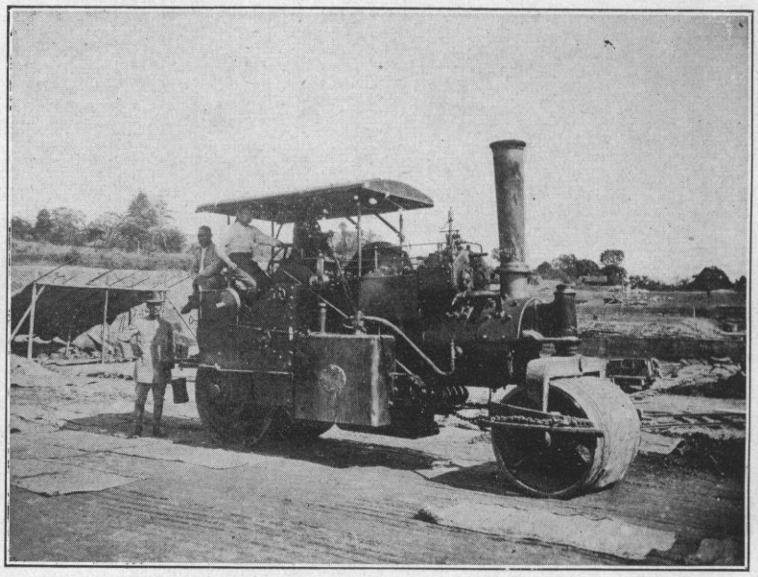
THE MURAYAMA-SAKAI LINE

Waste Weir

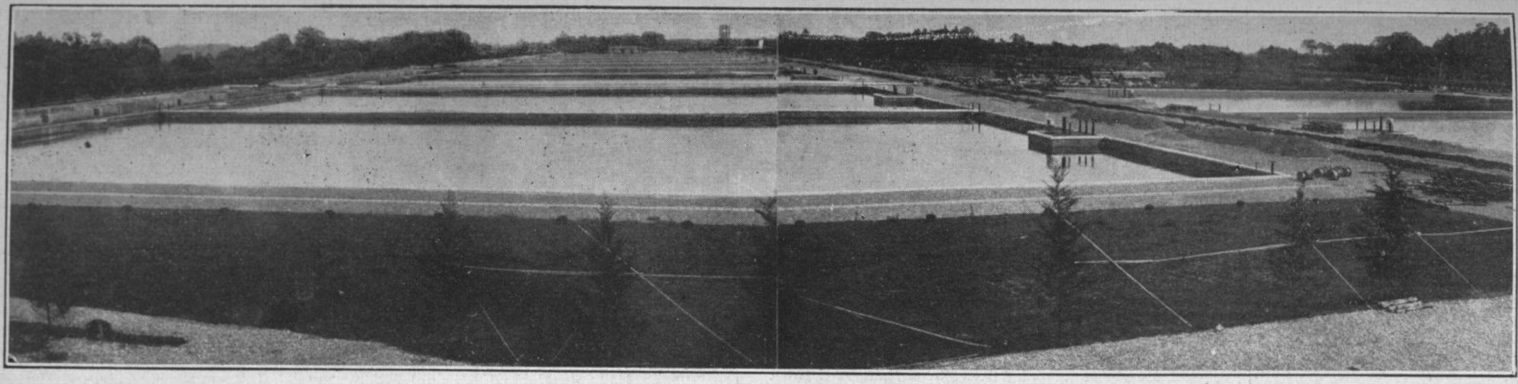
Water Falls for Reducing Pressure



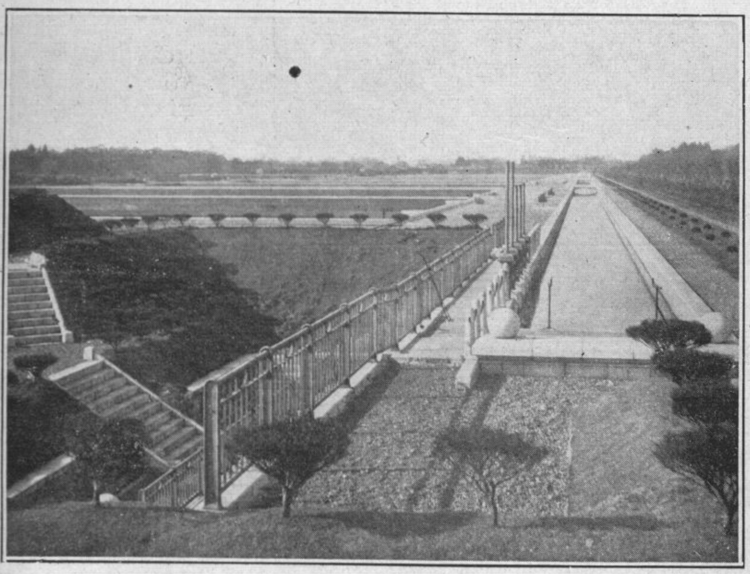
Bridge for Street Main

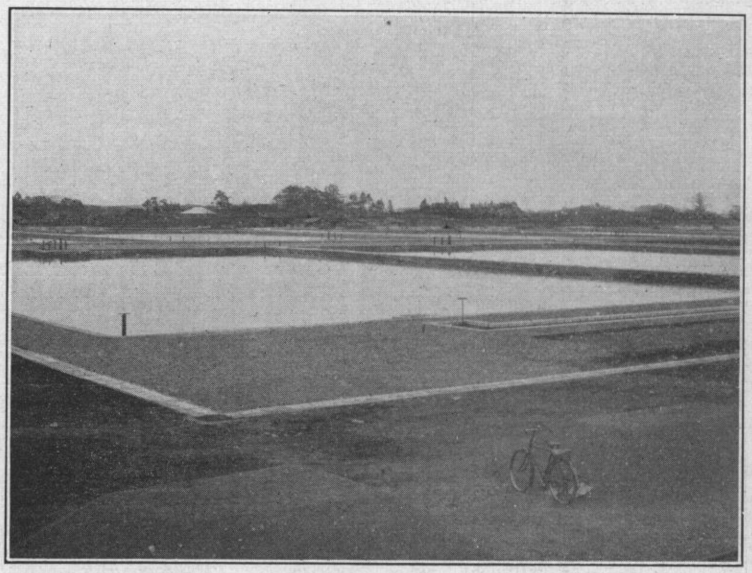


Steam Roller on Murayama Reservoir Dam

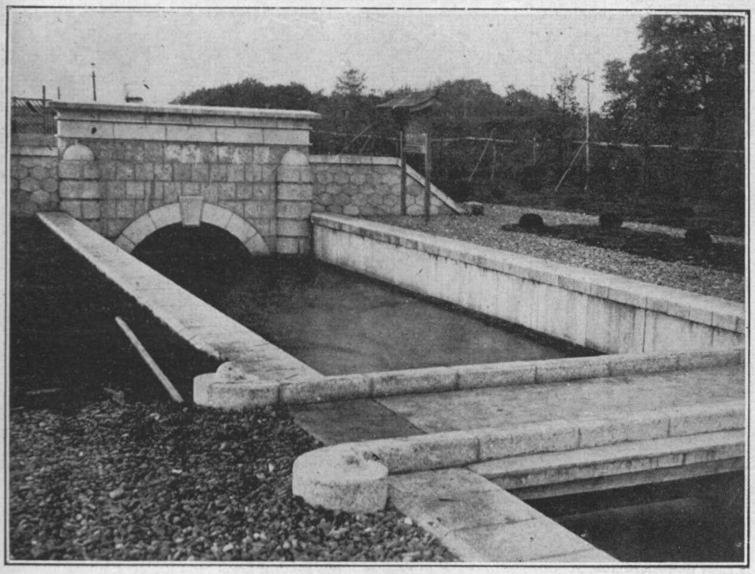


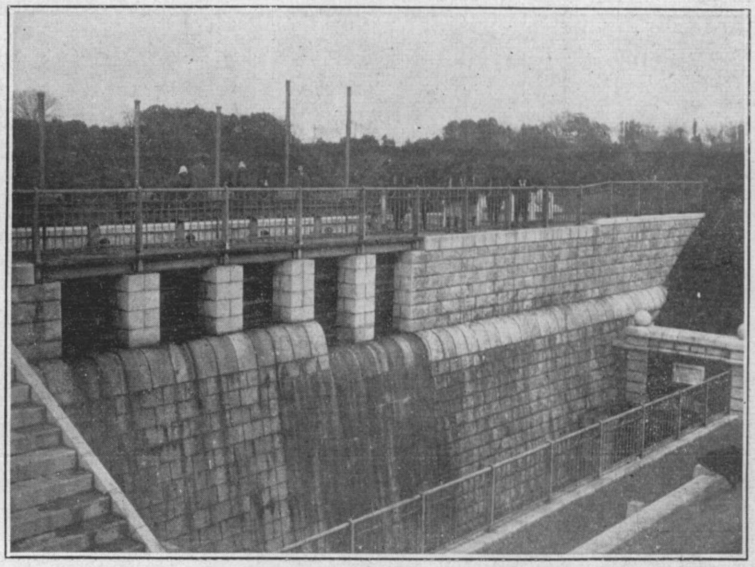
Sakai Filter Beds





Intake Canal and View of the Sakai Filter Beds





SAKAI FILTER BEDS

Inlet Open Canal

Submerged Weir at Terminal of Open Canal

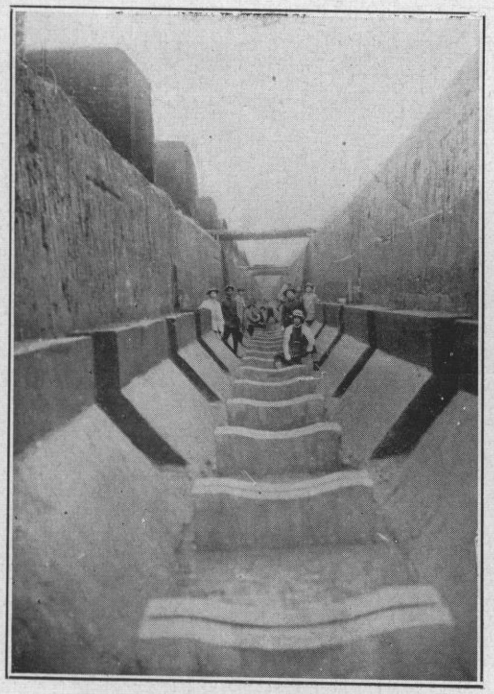
Higashi, Muruyama, Koganei and Musashino. The length of the line is about 7 miles with a gradient of 1-1,000 and 1-1,200 according to the location. The water depth is 5.6-ft. for the tunnel and 6-ft. for the conduit with a flow of 250 cu. ft. per second.

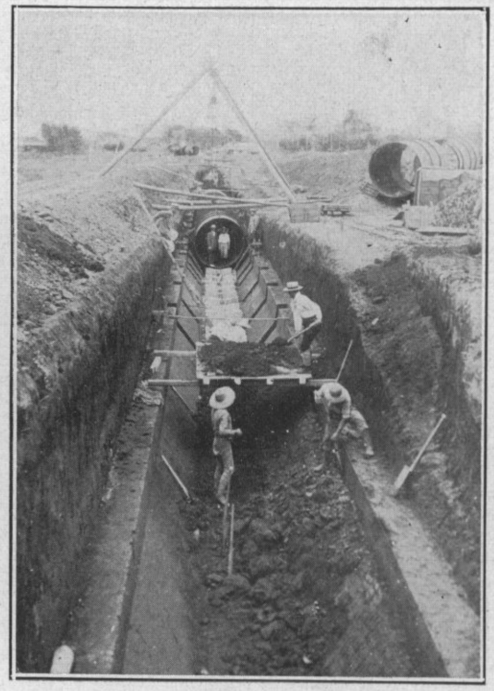
Sakai Filter Beds: Huge filter beds are constructed at Sakai village, where over half the water from the Muruyama-Sakai line flows to the filter beds through cast iron pipes and after filtration carried to the Wadabori service rsservoir through mortar lined steel pipes, designated as the Sakai-Wadabori line. The other half is delivered to the existing Daita aqueduct from the conduit of the Sakai-Wadabori line.

The total area of the Sakai filter beds is 23 acres to be divided into 20 sections, (of which, 12 are completed), filtering 100 cu. ft. per second. The filtering rate is 10-ft. in 24 hours, permitting three sections to be held in reserve or utilized for washing or other purposes.

Sakai-Wadabori Line: The water from the Sakai filter beds is conveyed to the Wadabori service reservoir through a 6-ft. 3-in. mortar lined and concrete protected steel pipe and a concrete conduit, 6.7 miles long, at a flow in the pipes of 100 cu. ft. per second. The mortar lined steel pipes convey the clear filtered water to the Wadabori service reservoir and the

concrete conduit carries the unfiltered water to the Daita aqueduct. This unfiltered water from the Muruyama reservoir, largely the overflow from the submerged weir located at the terminal of the open canal at the Sakai filter beds, flows into a collecting canal. The concrete conduit has a length of 6.3 miles with a gradient of 1-500 for the first 3.48 miles and 1-1,800 for the remaining distance, with a water depth of 3.65-ft. discharging at the rate of 125 cu. ft. per second.



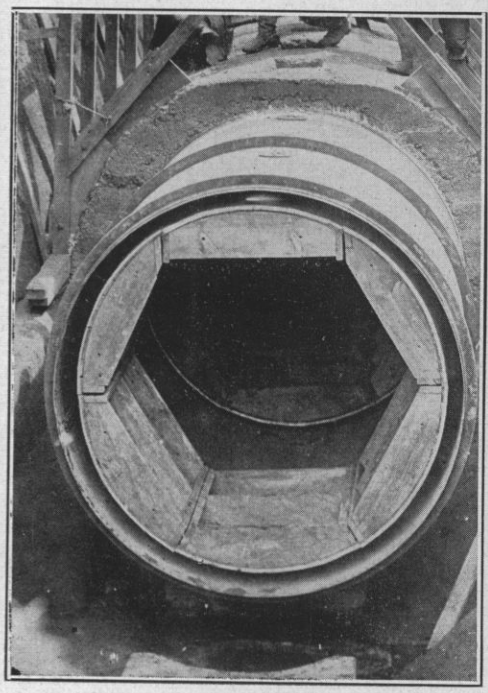


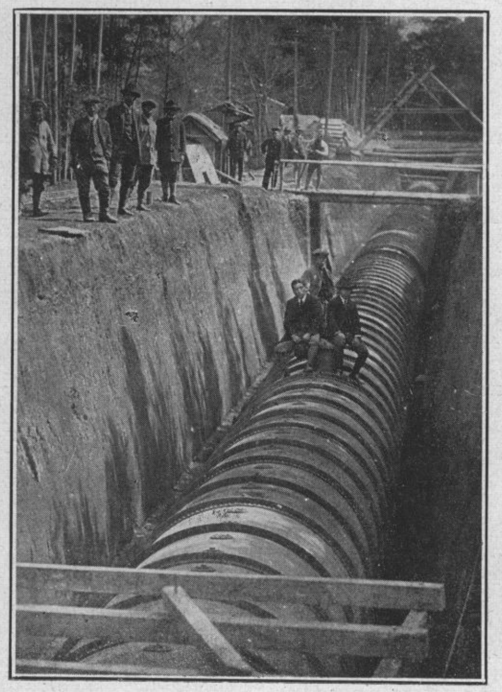
Concrete Cradle for Mortar Lined Steel Pipe on Sakai-Wadabori Line

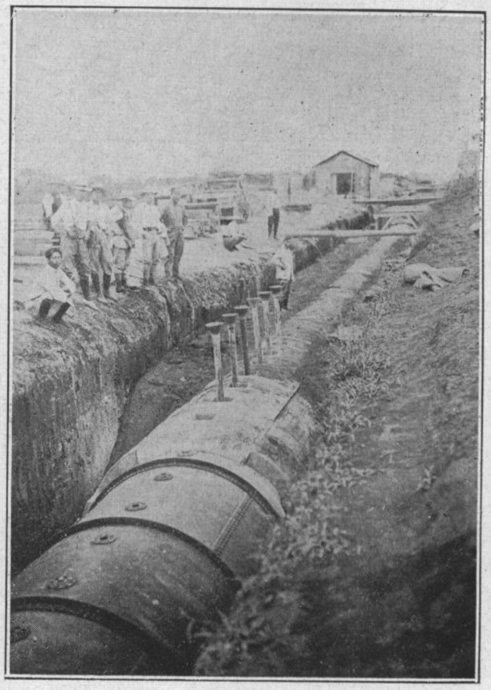
Wadabori Service Reservoir: This reservoir, located at Wadabori Village, and storing the filtered water coming from the Sakai filter beds, has a capacity of 3,000,000 cu. ft. The water level is 190-ft. above datum. The water from this reservoir is divided into two outlets.

Supply Mains: Two supply pipes 1,500 m.m. in diameter will carry the water from the Wadabori service reservoir in two separate directions connecting with the present gravity distributing system. Another main 800 m.m. in diameter will branch off from Oiwake, Shinjuku, to Sugamo, and be distributed to the high level districts served by the Yodobashi pumping plant. The proposed new mains will vary in diameter from 400 m.m. to 1,500 m.m. with a total length of 48 miles.

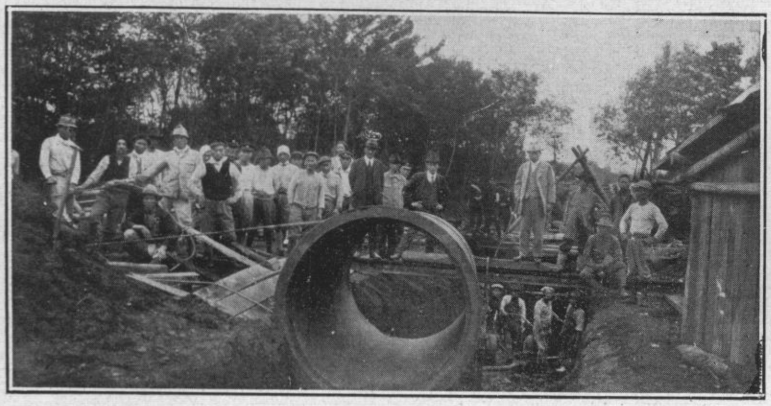
Street Sub-Mains: The length of streets and highways under which distributing pipes have still to be laid is estimated at 170 miles. Cast iron pipes will be used in all these streets as sub-mains.



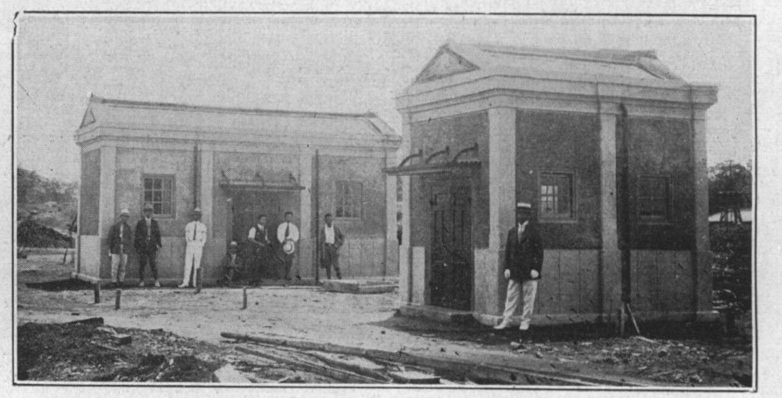




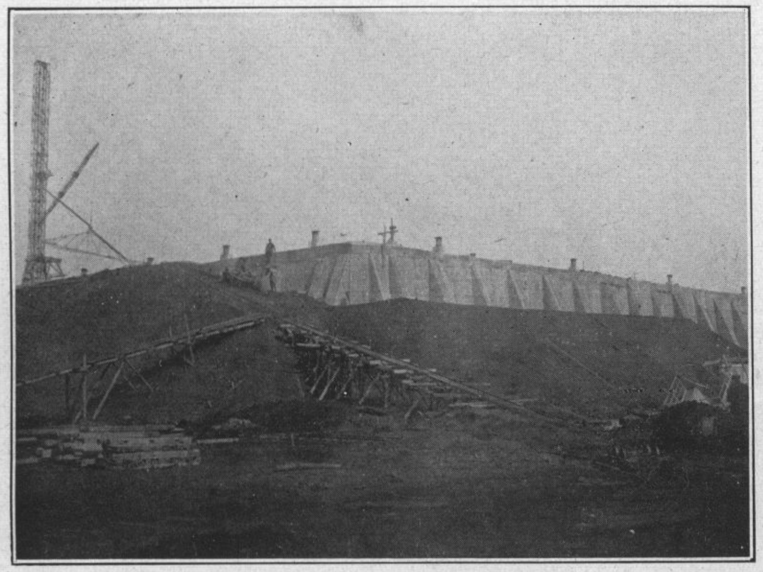
Laying and Grouting the Mortar Lined Steel Pipe of the Sakai-Wadabori Line

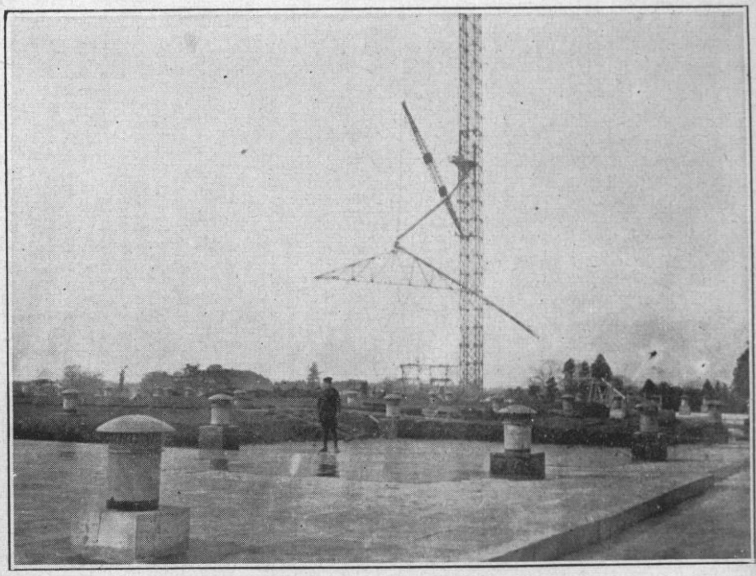


Setting Supply Mains, 1.5 meter Diameter, Wadabori to Aoyama



Valve Chamber at Wadabori

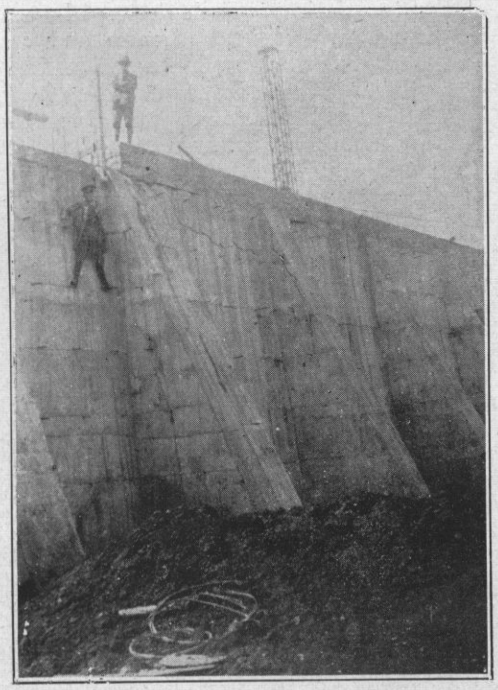




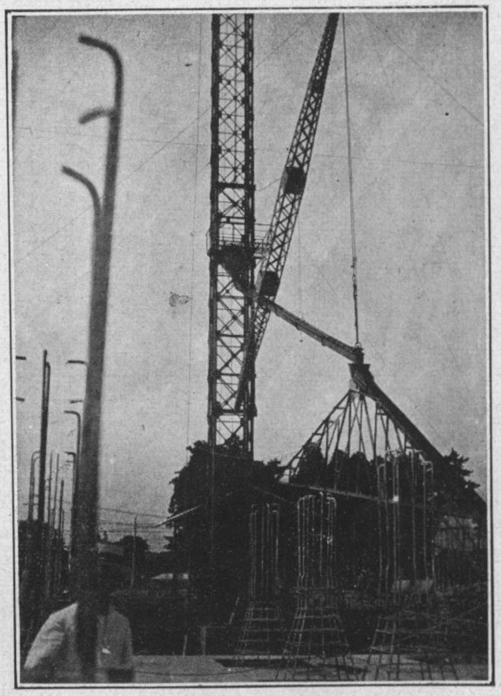
Wadabori Service Reservoir Showing Roofing

Earthquake Damage to Water Works System

The great earthquake caused considerable damage to the existing water works system of Tokyo. The Daita aqueduct, a concrete canal about 2½ miles long, conducting water from Daita to the Yodobashi station, was constructed about 36 years ago with embankments 10 to 50-ft. high. This canal was completely destroyed for a length of 120-ft while other parts settled, leaving another opening 120-ft. long. Large and small cracks occurred in about 240 places.



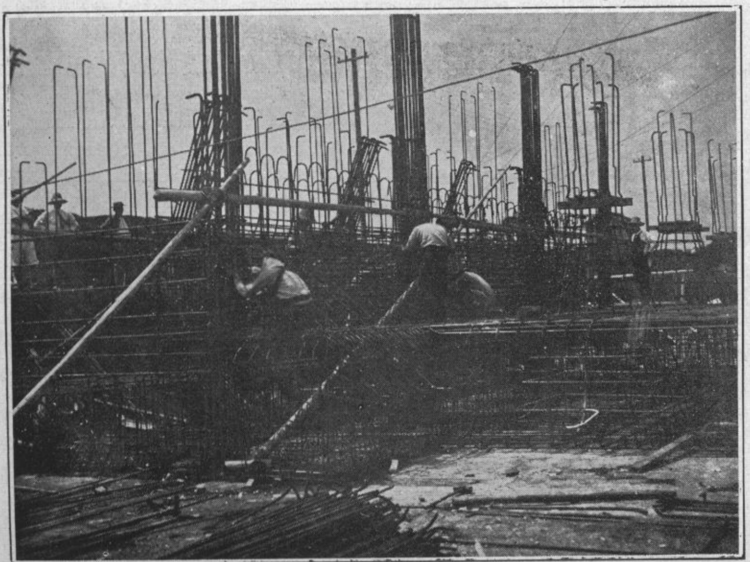
Cracks on Concrete Side Wall of the Wadabori Service Reservoir Made by Earthquake

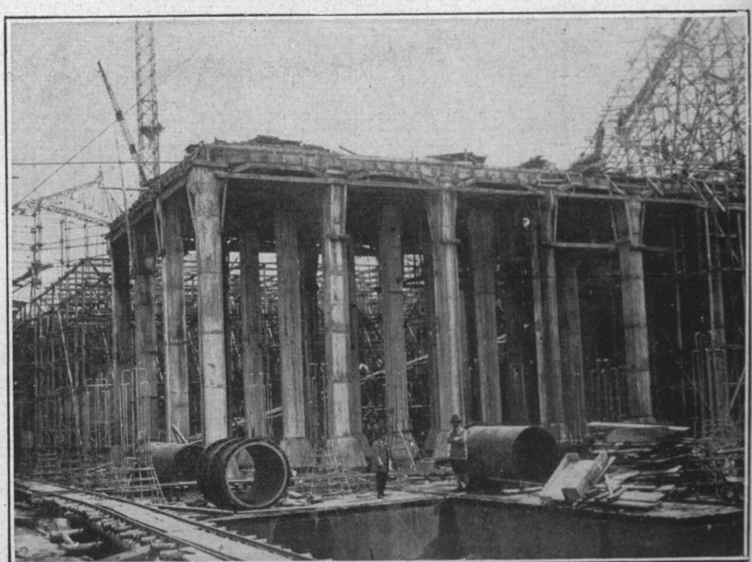


Construction Work on Wadabori Service Reservoir

At the Yodobashi pumping plant, the side wall and pitching of concrete blocks of one of the four basins was partly destroyed and 18 of the 24 filter beds badly damaged. Many cracks appeared on the side walls and beds of the service reservoirs while the pumping machinery was badly damaged and the two chimneys, 121-ft. high, were both broken off 10-ft. from the top. The plant was so badly damaged that it had to be closed down for repairs.

The distributing mains and the submains, (all socket and spigot cast iron

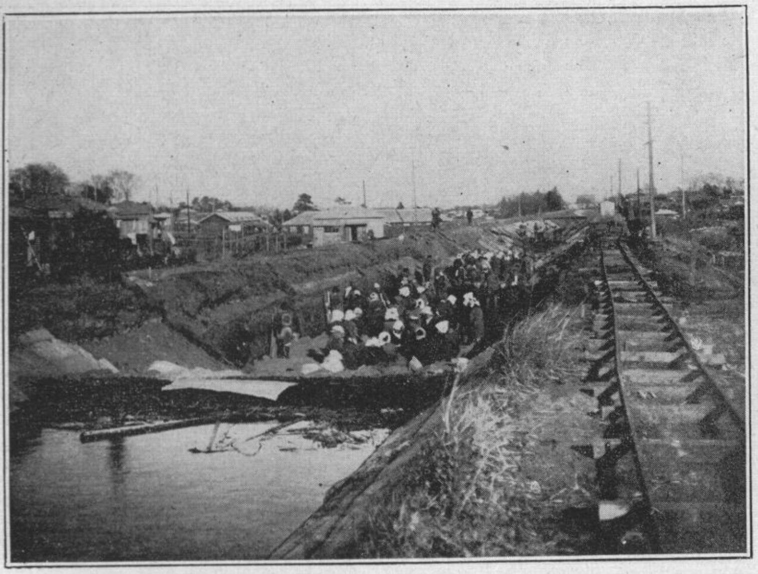
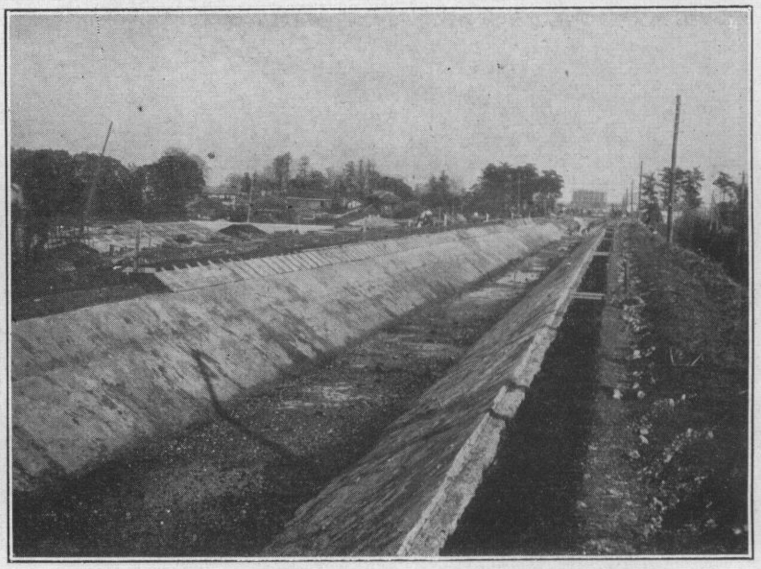




WADABORI SERVICE RESERVOIR

Arrangement of Reinforcing Bars

Pillars

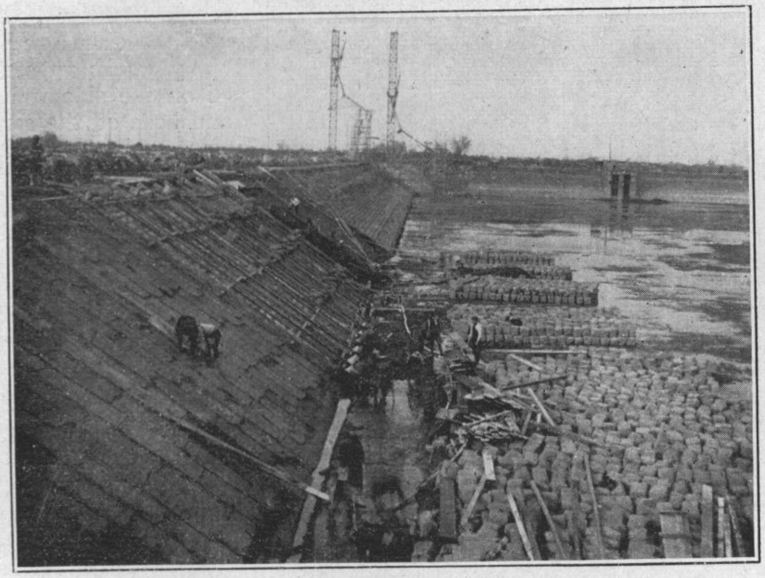
Repairing Earthquake Damage to the Daita Aqueduct

pipes), suffered the greatest damage. The number of broken and bent joints were 235, with 159 broken hydrants and valves and 268,682 loosened joints. Within 30 days after the earthquake, 438 miles of pipes in the distributing system, all the mains, hydrants, etc., were fully repaired and in working order. Of 241,675 water taps, 64 per cent. (155,103) were destroyed by the fire. By the end of September, 1924, 101,147 were replaced and working.

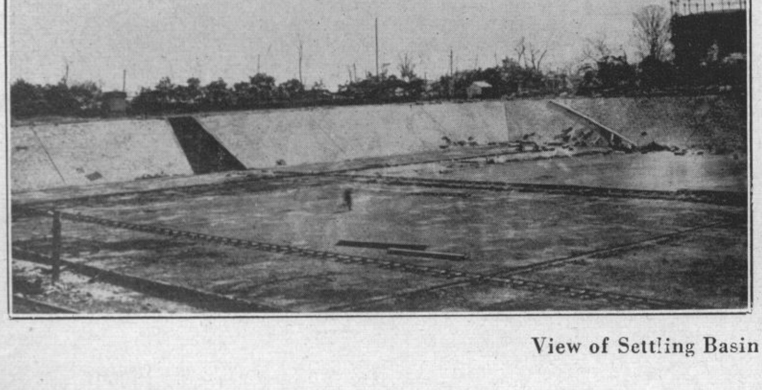
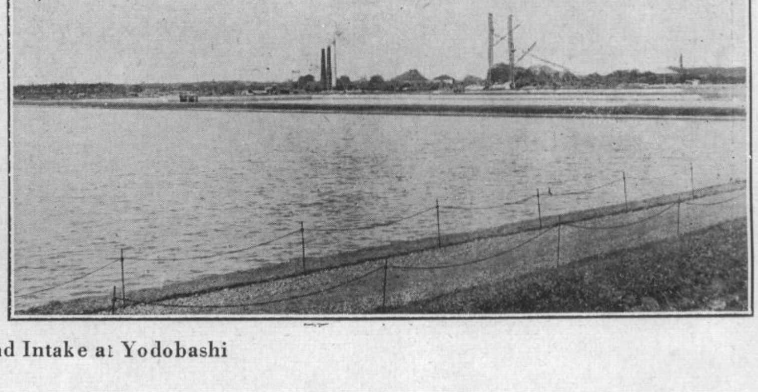
The upper dam of the Muruyama reservoir (completed three months before the earthquake), sunk 7-in. on its top surface while the 6-ft. by 6-ft. by 1½-ft. concrete blocks on its pitch were moved and twisted a few inches and sunk about ½-in. The wave protection wall in the reservoir was broken in three places; 90 per cent. of the top drainage ditch destroyed; the reclaimed land behind the dam sank 4-ft. in the centre and cracks 4-in. to 5-in. wide appeared at both sides. In addition, the drain ditch at the foot of the dam sank and was pushed and twisted off at many places.

The lower Muruyama dam, in course of construction, had been built up to 54-ft. from bed line (about half its total height). The force of the quake split it longitudinally for 200-ft. the fissure being 32-ft. deep.

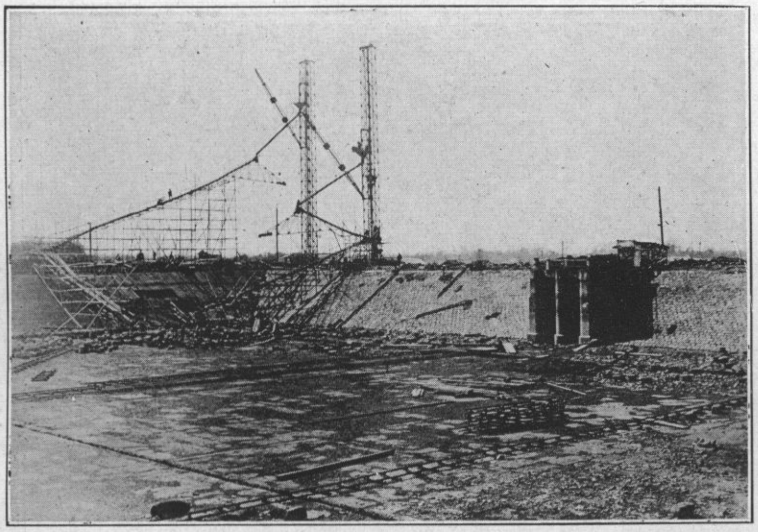
The partly reinforced horseshoe concrete conduit on the Muruyama-Sakai line developed several small hair cracks which were easily repaired. Twelve of the 20 filter beds at Sakai, completed before the quake, being heavily reinforced at the corners, stood the shocks without damage. The inlet open canal, however, was



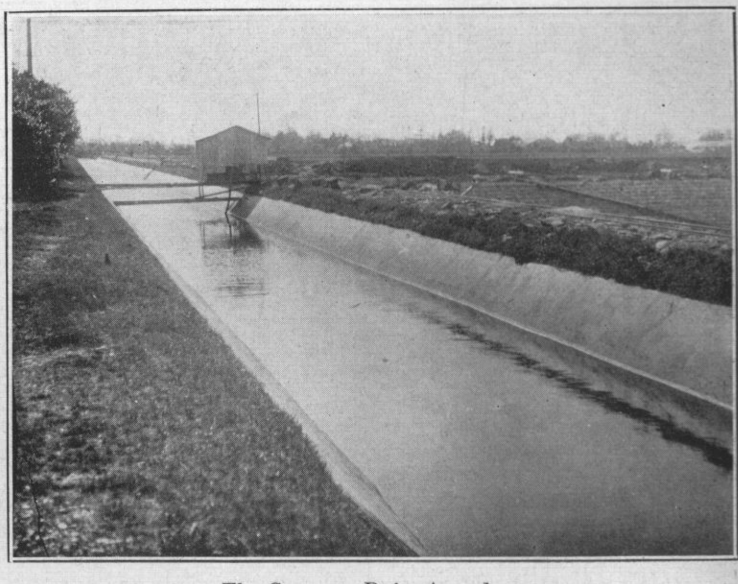

Repairing Earthquake Damages to the Yodobashi Filter Beds

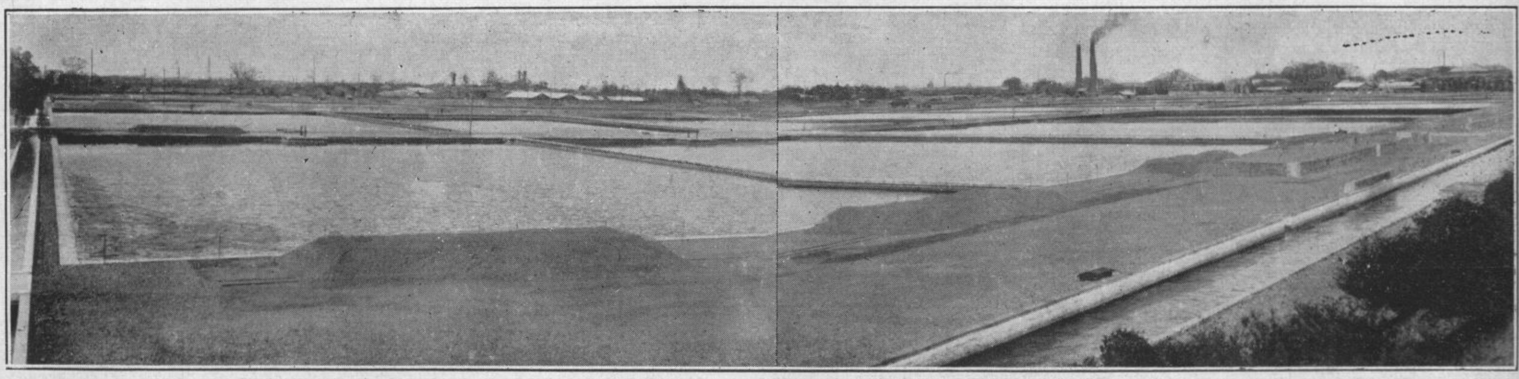
View of Settling Basin and Intake at Yodobashi



Repairing the Settling Basin at Yodobashi



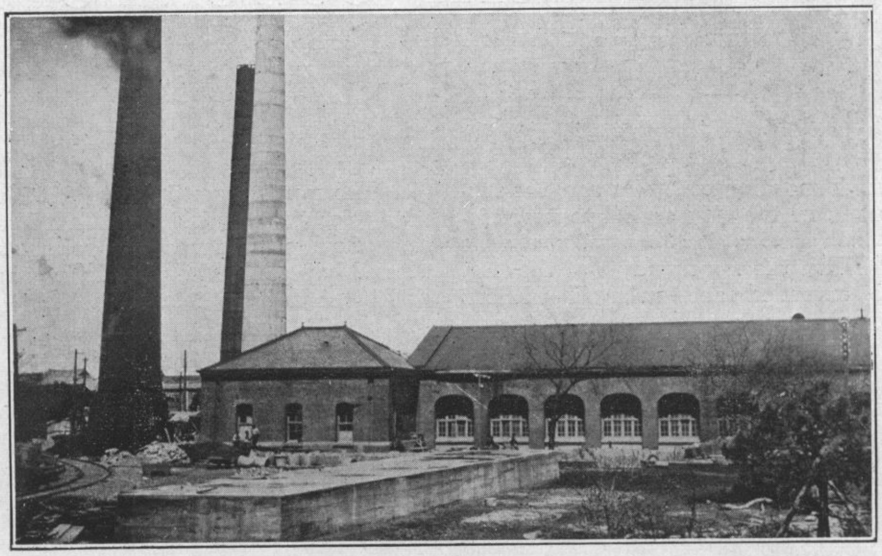
The Concrete Daita Aqueduct



The Filter Beds at Yodobashi

broken at six branch points to the filter beds and developed a crack ⅜-in. wide and 246-ft. long The outlet conduit was also broken at four branch points where connections were made to earthen pipes by concrete joints.

Many small longitudinal cracks appeared on the inside of the mortar lined steel pipe on the Sakai-Wadabori line and others on the outside concrete finish, from which it would appear that the hammering inside the pipe caused by the seismic shocks, loosened the cement from the steel.



The Yodobasih Pumping Station

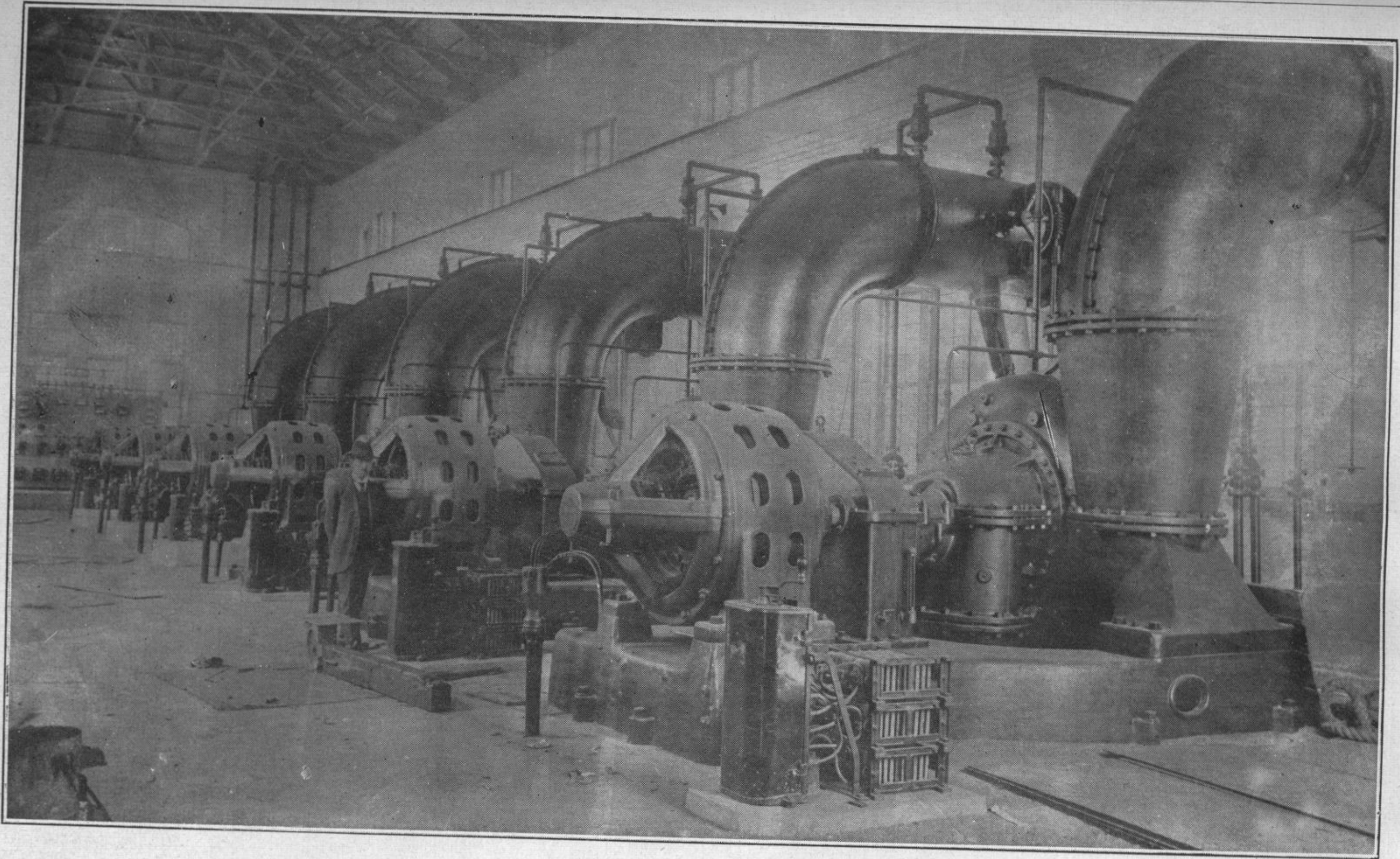
The earthquake damage to the water system was most severe at the Wadabori service reservoir, then in course of construstion. The reinforced concrete side wall, includiug the butresses and footing slabs was completely destroyed in 20 different places, the top of the wall and the connections between the wall and roof receiving the greatest damage. The breakage at these points was so severe that great masses of corcrete were shaken loose and thrown down, exposing the bent and twisted reinforcing bars. Out of 304 reinforced concrete pillars supporting the roof, only 72 come through the quake undamaged.

The expansion and contraction joints in the roof spaced 27 to 56-ft. longitudinally and crosswise, in order to prevent cracking, suffered great damage, while a part of the roofing concrete finished five days before, sank about 6-in. due to the sliding action between the pillars and roofing concrete.

The Reconstruction Budget

(*Continued from page 251.*)

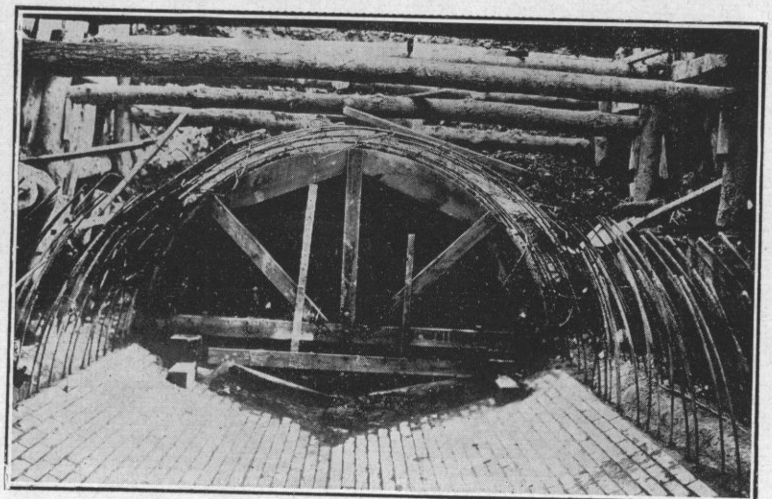
In any consideration of Japan's financial position due to the losses inflicted by the earthquake and fire it should be remembered that the area affected was but a small part of the empire, in the main a center of consumption rather than of production. The estimated property losses represent less than three per cent. of the total wealth of the empire. None of the silk filatures were in the damaged districts, and only about ten per cent. of the country's cotton spindles were destroyed. The capacity of the Japanese people for industry and trade has been only slightly and temporarily affected, and the total losses due to damages and destruction of property will be made good in a comparatively short period by the energy and thrift of the people and the general retrenchment program now being carried out by the Government.



Tamachi Pumping Station

Tokyo's Modern Sewerage and Drainage System

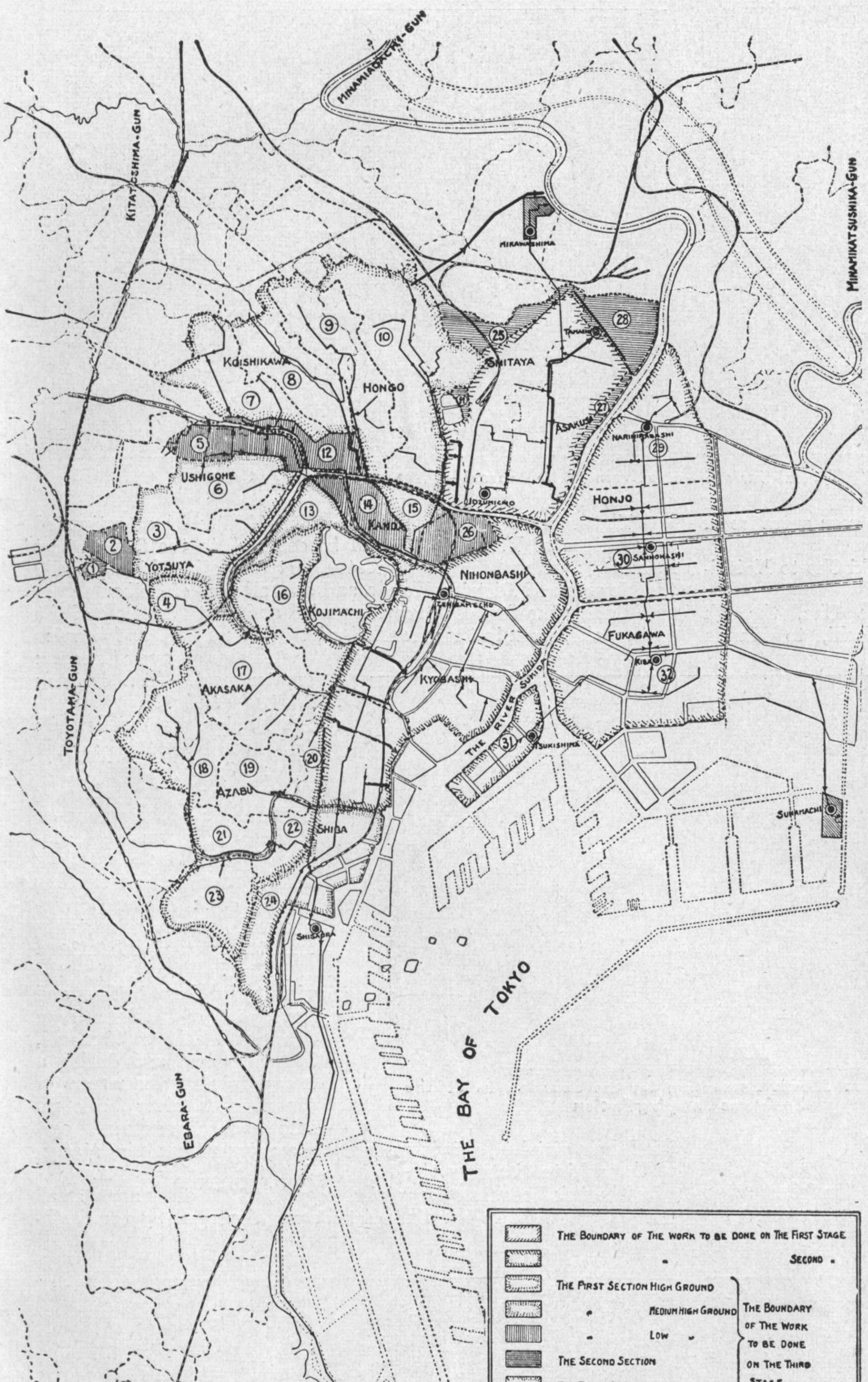
FROM the time of its foundation centuries ago, the surface and waste waters of the city of Tokyo were discharged through open drains into moats, navigable canals and rivers. With the development of the city, these drains were extended and enlarged without system to a point where the public health became endangered. A conflagration which wiped out the Ginza business section in 1871 paved the way for the construction of modern buildings and improved street facilities, and in 1876, the demand for modern sanitation received further accentuation from a violent outbreak of cholera. The Department of Home Affairs at that time authorized the laying of sewage and water mains but work was delayed owing to insufficient funds. Investigations, however, were continued, and with the assistance of an English engineer named Burton, (at that time adviser to the Department of Home Affairs) a sewerage scheme was drawn up but could not be carried into execution until plans for the waterworks system were completed and approved.



Main Sewage Line, Built during the First Construction Period

The years from 1893 to 1905 were devoted to a thorough survey of the conditions and needs of the city, resulting in complete new plans for a sewage system. In July, 1909, the city Assembly petitioned the Minister of Home Affairs for governmental assistance to the extent of half the estimated cost of the proposed sewerage improvements. A second petition submitted in 1911 elicited the response that as soon as financial conditions were favorable, the Imperial Government would contribute a fixed sum whenever the city started the work on its own initiative. The municipal authorities then appropriated Y. 6,130,000 for sewer construction whereupon the Imperial Government agreed to defray one-third of the estimated costs of construction.

The city of Tokyo, built largely upon reclaimed land at the mouth of the Sumida River is cut by dozens of small streams flowing down from the hills on which are located the residence districts of the city. Many of these streams have been connected or diverted into artificial moats while others act as drainage canals for the frequent heavy rainfalls and the refuse waters of the city.



A PLAN FOR THE SEWERAGE SYSTEM OF THE CITY OF TOKYO.

Map of Tokyo Sewerage and Drainage System

The floods of 1910 focused attention on the immediate need of adequate drainage for the city and in the following year plans for a new system were drawn up and approved by the Diet. Work was commenced in 1912, and when the earthquake occurred, several of the most important features of the new system had been completed.

The rapid growth of the city made an adequate drainage system imperatively necessary, for as the suburbs expanded, the streams which served as natural drains were surcharged with sewage before entering the municipal boundaries. Many of these streams, such as the Sen, Otowa, Edo, Waseda and Furu Rivers (each of these names in Japanese ends with "kawa," meaning "river") had to be utilized as the main drainage canals in the new system.

The approved plan provides for the concentration of all the drainage and sewage of Tokyo and surrounding districts into three disposal plants located at Sunamachi, Mikawajima and Shibaura, the last being a temporary plant to be replaced later on by the Rokugo Plant at the mouth of the Rokugo River. Wherever practicable, all surface drainage will be discharged into near-by streams, ponds and moats, while the sewage will be carried to the disposal plants for purification and discharge into the Sumida River and Tokyo Bay.

The new scheme is based on an estimated population of 3,000,000 with a sewage of 6 cub. ft. per capital per day. To this amount (18,000,000 cub. ft.) the highest rainfall, estimated, at 2-in. an hour is provided for, or another 18,000,000 cub. ft. making a total of 36,000,000 cub. ft. a day. In order, however, to discharge this volume rapidly, the plans for the new system have been drawn to carry off 36,000,000 cub. ft., in the space of eight hours, thus leaving an ample margin of safety.

The plans divide Tokyo into three districts:

FIRST DISTRICT: Comprises all of Shiba, Azabu, Akasaka, Yotsuya, Ushigome, Koishikawa, Hongo, Nihonbashi, and Hyobashi Wards; also the greater part of Kanda and a small part of Shitaya.

SECOND DISTRICT: Comprises Asakusa, the greater part of Shitaya and a small part of Kanda Ward.

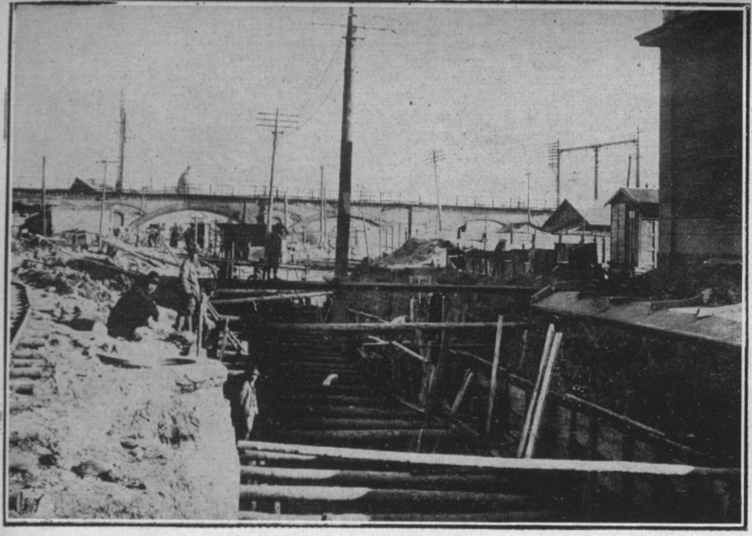
THIRD DISTRICT: Comprises Honjo and Fukagawa Wards; Since the earthquake, Tsukishima, locatéd in Kyobashi, has been added to this district.

Construction Periods

In the first construction period (1911 to 1923), which work was pushed forward and almost completed in the second district. The cost of construction up to the end of 1924 approximated Y.15,000,000, while repairs necessitated by the earthquake calls for Y.374,000. Most of these repairs are required at the Mikawajima disposal plant.

During this period, urgent work at the following places in the first district was completed at a cost of Y.2,500,000.

(1) *Shiba Ward*: From Atago Machi to Gensuke Cho, 3,602-ft.
(2) *Shiba Ward*: From Shirokane Imazato Machi to the Furu River, 4,568-ft.
(3) *Akasaka Ward*: From Aoyama Minami Machi to the front of the Red Cross Hospital in Azabu, 5,629-ft.
(4) *Yotsuya Ward*: From Nagazumi Cho to Ushigome Ichigaya Honmura Cho, 5,642-ft.



Widening an Old Drainage "Moat." Typical Surface Water Drains: The Debashi—Toranomon Drainage Canal

(5) *Yotsuya Ward*: from Tani Machi to the rear entrance of the Aoyama Palace, 1,270-ft.

(6) *Ushigome Ward*: From Waseda Tsurumaki Cho to Koishikawa Edogawa Machi, 2,094-ft.

(7) *Shitaya Ward*: From Yanaka Majima Cho, through Hongo Ward Komagome Sakashita Machi, to Kanda Ward, Manseibashi, 15,162-ft.

The second construction period began in 1920 and at the time of the earthquake, 21.5 per cent. had been completed as follows:

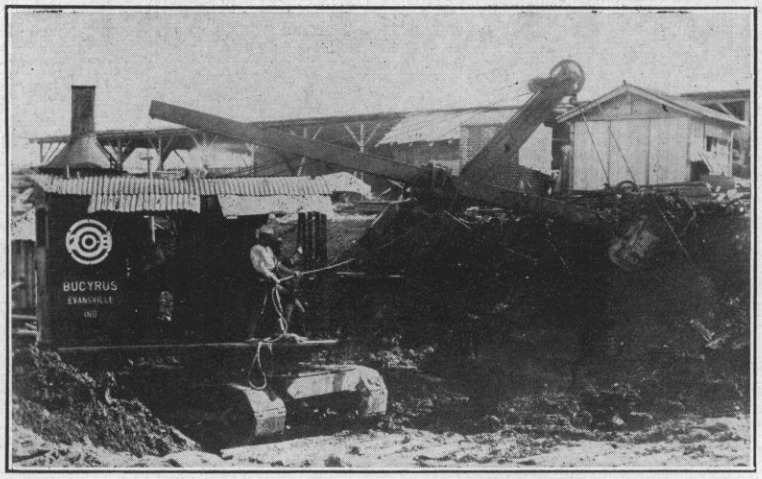
(1) Ote Mon to Shibaura, one portion of the main line of sewage and drainage mains.

(2) Ote Mon to Zenigame Machi pumping station, forming one portion of the high level line.

(3) One portion of the branch lines in Marunouchi district, and in Kyobashi and Nihonbashi Wards.

Total: *Main Line*:
Planned, 45,956-ft.; Completed, 4,232-ft.
Branch Lines: Planned, 607,190-ft.; Completed, 108,330-ft.

The foundations of the pumping station at Zenigame were also completed, and the equipment is now being assembled for installation.



Bucyrus Steam Shovel Excavating for the Foundations of the Zenigame Pumping Station

The second construction period (1921-1928), with an estimated expenditure of Y.20,000,000, will be confined to the first district including: Nihonbashi, the greater part of Kojimachi, especially the Marunouchi District, Kanda and a small part of Shiba.

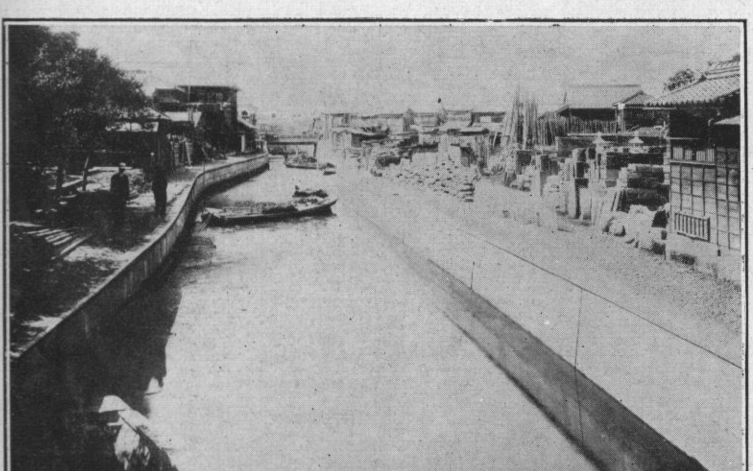
During the first construction period and up to the time of the earthquake, work in the second district was completed as follows:

Asakusa and Shitaya: greater part. Area drained; 2,130,000 *tsubo*.

Equipment Planned: 14,880-ft., of main sewage pipe; 8,422-ft., of main drainage and sewage pipes; 15,531-ft., of drainage pipes 407,342-ft., of branch drainage pipes: Manholes, light holes, automatic flushing valves, etc.: Sewage, drainage and sedimentation tanks and two pumping stations.

Kanda Ward, in the vicinity of Izumi Cho, and that part of Asakusa near Senzoku Machi in Tamachi, is low ground and during a heavy rainfall, the waters of the Sumida river back up into the moats and canals and flood these districts, so it is necessary to construct a pumping station at Tamachi to discharge the drainage into the Sumida River.

The third construction period began in 1922 and only a small part of the work in the first district was damaged by the earthquake.



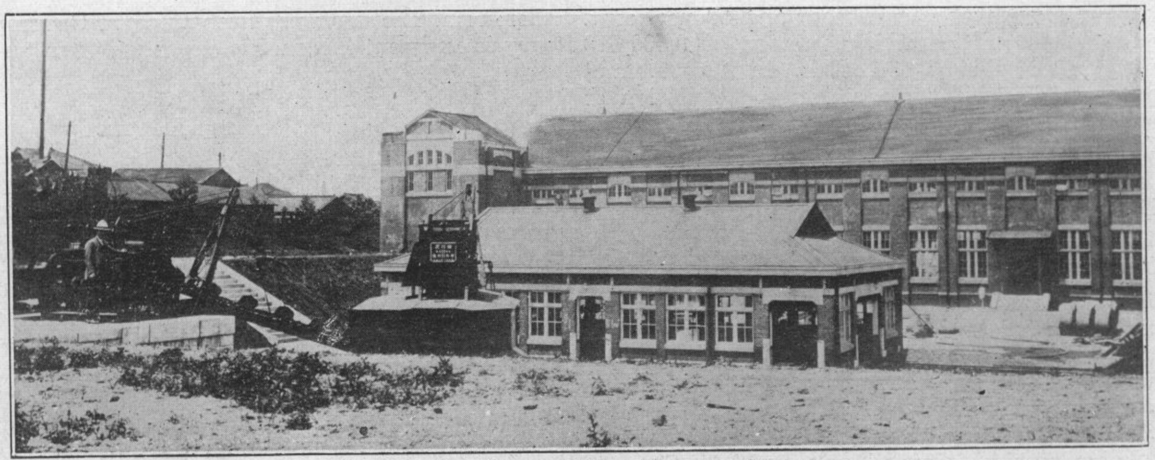
Typical New Style Open Drainage Canal: The Senzoku Bori

Constructing Foundation for the Zenigame Pumping Station

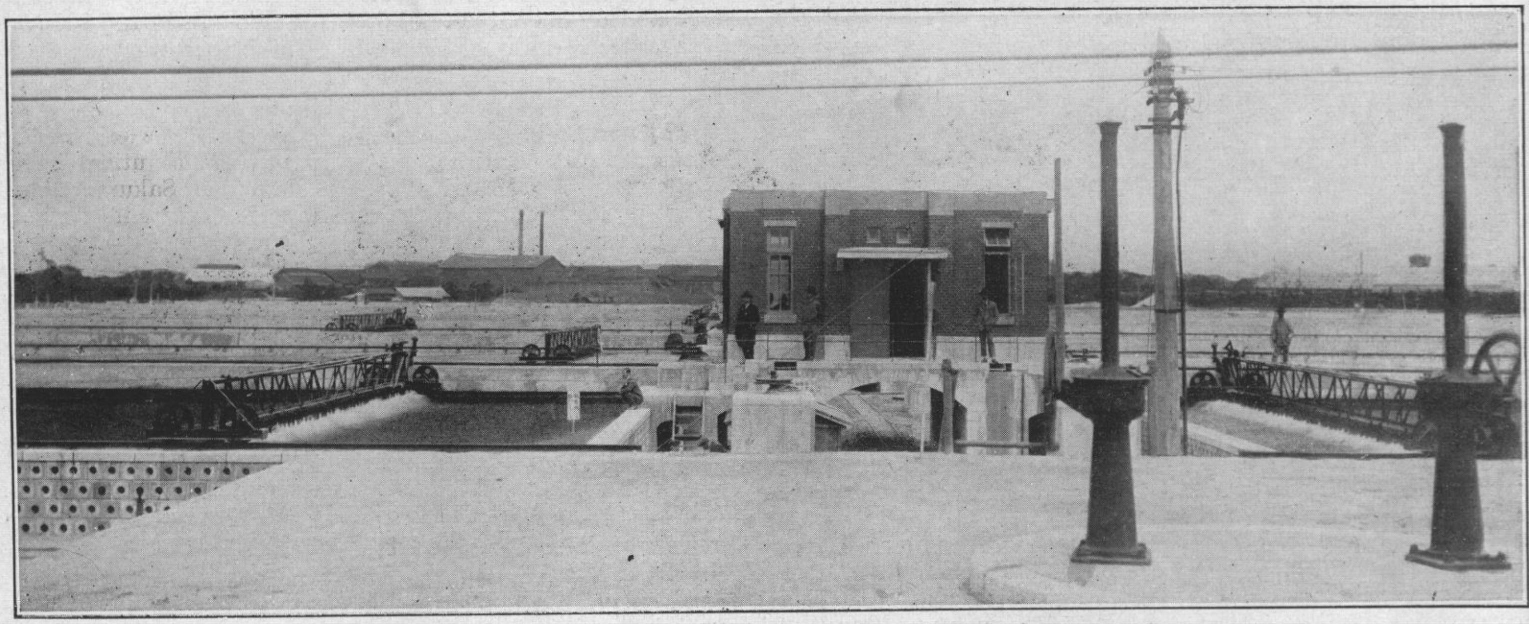
The work completed was: Kanda Ward; That part included in the first district; Kojimachi Ward: Marunouchi district; Main Line: All completed: Branch Lines: Half completed: Area drained: 701,064 *tsubo*.

The length of sewage mains to be built in this period totals: 56,161-ft., of main lines and 82,863-ft., of branch lines, serving a present population of 109,030, with provision for 134,524.

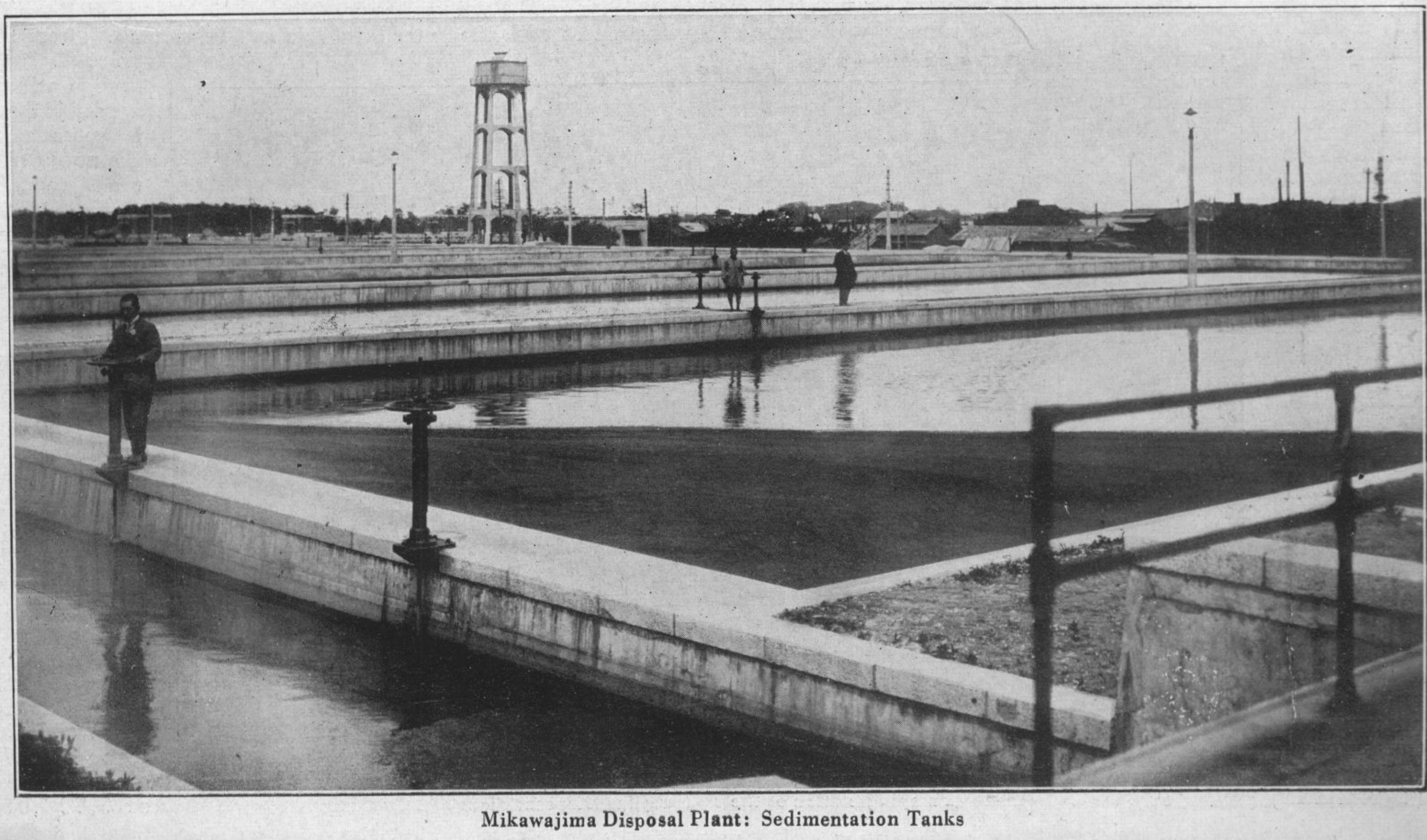
During this period, construction will be completed in the third district, comprising the Fuka-



Mikawajima Disposal Plant: Pumping Station



Mikawajima Disposal Plant: Filtration Beds



Mikawajima Disposal Plant: Sedimentation Tanks

gawa and Honjo Wards. All the main lines and 55 per cent. the branch lines are to be built, draining an area of 3,503,618 *tsubo*. The main sewers will be 35,302-ft. in length, and 181,263-ft. of branches. This will serve a present population of about 477,403, and a future increase to 625,337.

During this period, the Sewage Disposal Plant at Suna Machi will also be constructed, as well as three pumping stations located at Narihira Bashi, Mitsuhashi and Kiba.

The total estimated cost of the Tokyo Drainage and Sewage System is Y.43,500,000, itemized as follows :

Office expenses	Y. 2,361,000
Earthquake damage repairs	374,000
First construction period (for repairs) ...	220,000
Second construction period	15,110,000
Third construction period :	
First district...	4,499,000
Third district	18,473,000
Miscellaneous construction costs	1,250,000
Miscellaneous charges	1,213,000

Of the total original budget, Y.33,850,000 had been expended by the end of 1924, leaving a balance of Y.9,600,000 to be applied to carry out the unfinished work.

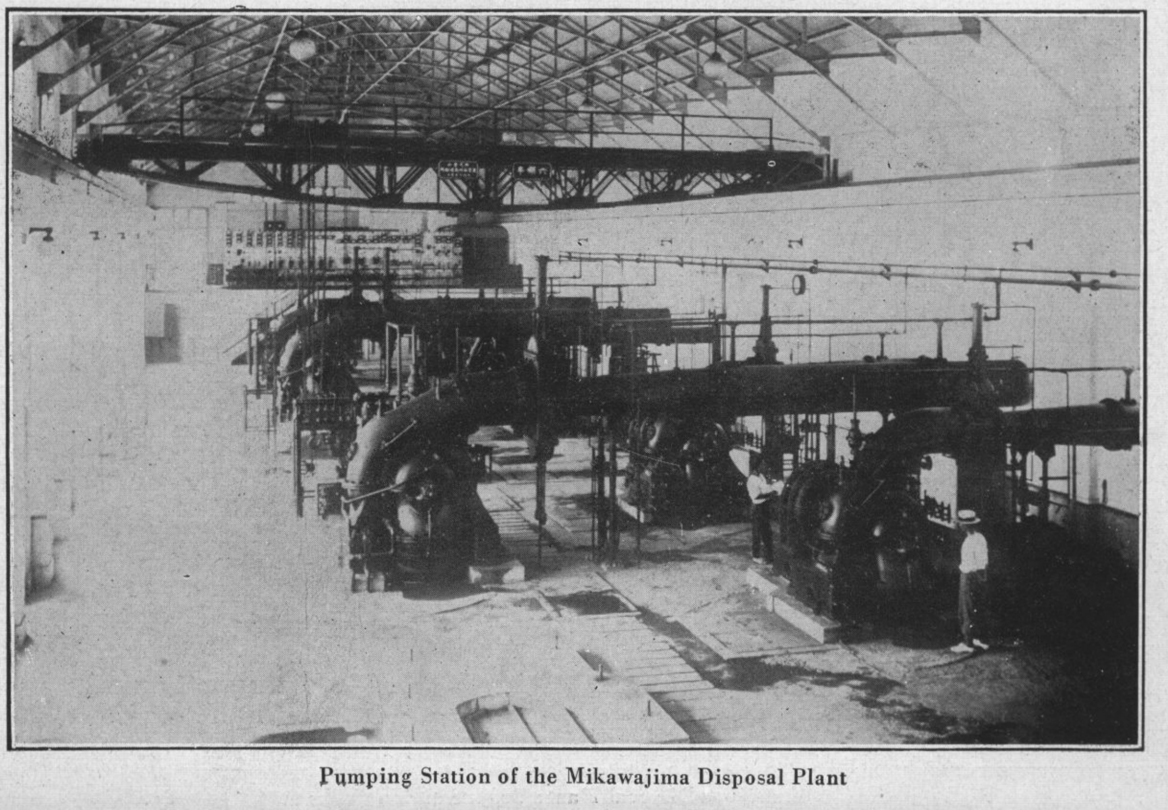
Damage Caused by Earthquake and Fire

The total damage sustained by the sewage and drainage system was comparatively small, being only Y.1,350,000, of which Y.382,500 represents the damage to the Mikawajima disposal plant and the Asakusa Tamachi pumping station. Little damage was done to any work completed during the second construction period.

The damage at Mikawajima and the Tamachi pumping station will be repaired by 1926. Up to the end of the fiscal year, ending March 31, 1925, about 30.8 per cent. of the damage sustained at Mikawajima, and 2.2 per cent. of the repairs to the Tamachi pumping station had been completed.

The new budget for sewer and drainage works is spread over five years (1924-1929), and supervision of the work entrusted to the reconstruction authorities. This budget provides for carrying to completion the second and third period programs (together with such repairs as were necessitated by the earthquake) before the end of 1919. One-half of the funds are to be provided by the Imperial Treasury, the balance to be raised by the issue of Municipal Debentures. Such work as may remain unfinished at that time to complete the original plans of 1911, will be postponed until 1930 and carried along for another seven years at a cost of Y.78,450,000.

Although the National Subsidy will be the principal source of funds, official approval has recently been given to a plan for placing the burden of the costs of all branch drainage and sewer construction on the property owners benefitting therefrom. The sanction of the Imperial Government is still necessary to carry out this radical departure from traditional customs.



Pumping Station of the Mikawajima Disposal Plant

First District

This district, embracing eight city wards is the most important of the three drainage divisions of Tokyo and owing to its great area has been further divided into high level, mid-level, and low level sections.

The surface drainage of the whole district will be discharged into the streams and moats, while the sewage and refuse will be concentrated at Shibaura for pumping to the projected disposal plant at the mouth of the Rokugo River, half way between Tokyo and Yokohama. The Shibaura pumping station will be provided with a collecting tank of sufficient capacity to hold the accumulated discharge for the district for three hours.

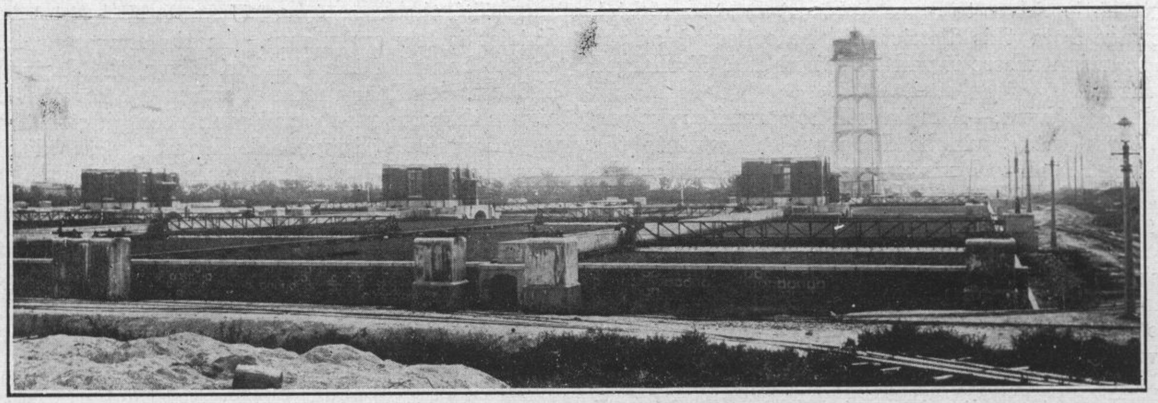
The High Level Section.—The district covered by this section includes parts of Kojimachi, Shiba and Yotsuya and all of Azabu and Akasaka, the total drainage area being 4,437,000 *tsubo*, with a length of drains of 702,600-ft. This district is comparatively free from floods and the natural slope permits the waters to flow by gravity to the collecting tank at Shibaura.

Kojimachi.—Part of the surface drainage will be discharged into the inner moat. The moat embankment will be utilized to hold the main sewer which will have an outlet at Sakurada Gate in order to partially discharge the excess storm waters into the moat. The balance, together with the sewage, will be carried on to Toranomon, Yotsuya and Akasaka Wards. The main sewer will commence at Samegahashi, Tanimachi, where all the drainage of the first district will be concentrated. An outlet for storm waters will be located in the rear of the Akasaka Palace and from this point carried to Tameike, thence to Toranomon to join the main line from Kojimachi Ward. Surface waters will be conducted to Dobashi and discharged into the Shimbashi River.

Aoyama Ward.—Storm waters and sewage will be collected along the line of the Furu River, and carried to Sannohashi in Shiba Ward through a new covered moat. Connection will be made at this point with the main sewer from Sannohashi in Shiba Ward.

Shirokane, Shiba Ward.—The major part of the storm waters from this district will be discharged into the Furu River. Sewage will be carried to Sannohashi and discharged into the main line from Aoyama. Passing through Mita Dobo Cho to Shibaura it will connect with the lower level line at Fudanotsuji. From this point the sewage will be carried in double pipes along the newly built road to Shibaura. The largest sewer, between Mita Dobo Cho to Fudanotsuji, will be of the horseshoe type with a width of 9-ft. and a height of 8-ft. 1-in.

Mid-Level District. — This district includes the greater part of Hongo, a part of Koishikawa, Ushigome, Totsuya, Kojimachi, Kanda, Shiba and Shitaya Wards, draining an area of 6,793,000



Filtering Bed: Mikawajima Disposal Plant

tsubo calling for 1,458,000-ft. of sewers

All the storm waters from this district will be discharged by gravity into nearby moats and streams, the sewage flowing to the collecting tanks at Shibaura.

Yotsuya and Ushigome Wards.—The open moat at Aizumi Cho leading through Honmura Cho to Ichigaya Mitsuke, will be covered, and both storm waters and sewage collected. At Ichigaya Mitsuke, the storm waters will be discharged into the outer moat, and the sewage conducted to Iidabashi, connecting there with another main coming from Ushigome Yanagi Machi. From this point, the greater part of the storm waters will be discharged into the Edo River and the sewage conducted to Iidabashi and discharged into the Ichigaya mains.

Kojimachi Ward.—Bancho Main: This main will discharge surface waters into the outer moat, and carry the sewage to Iidabashi where it connects with the Ushigome and Yotsuya mains. From Iidabashi, it will flow to Kudan Shita, where, chainging direction, it will pass the Department of Finance and connect with the main from Kanda Ward.

Koishikawa Ward.—The Zoshigaya main will meet the Otsuka main at Kokokuji Mae, carry the flow to Edogawa Bashi, and discharge the surface water into the Edo River. Changing direction, it will then go on to Suidobata Machi, and passing to the west of Suidocho, will serve the Ushigome Tenji Shrine and the Artillery Arsenal. Here a tunnel will be dug through the grounds to Tomisaka, connecting with the Sen River.

Sen River Main.—This is the main collection line for surface waters and sewage from the suburban and country districts. A new bed is to be constructed from Itabashi station to the Shakuji River and on to where the latter joins the Sumida River. This line will serve the suburbs to the south of the railway, and follow the new projected roads to Tomisaka connecting here with the Suido Bata main. Sewage will be carried on to Tomisaka Shita and connect with the Haramachi Line. Storm waters will be discharged through the Arsenal moat into the Kanda River.

Haramachi Main.—This main will gather all storm waters and sewage, connecting below Hakusan, with the line from Akebono Cho. A part of the storm waters will be discharged into the existing moat emptying into the Sen River. Excess storm waters will also be discharged through this covered moat into the Kanda River, and the surplus carried along to Suidobashi, across the Kanda River to Sarugaku Cho, and Nishiki Cho Sanchome and then discharged into the outer moat, the sewage flowing into the Hongo line.

Hongo Line. — A new canal will be constructed from a point below Dozaka to the Sumida River collecting the storm waters from the suburban districts. This will necessitate rebuilding the existing canals. A concrete covered sewer will collect all sewage and storm waters in this district and discharge part of the storm waters into the Shinobazu Pond below Uyeno Park. Sewage and storm waters from the higher parts of Hongo will be collected and discharged at Ikenohata Nakamachi.

The area of Shinobazu Pond is 43,000 *tsubo* and its water level can be raised one foot without inundating the surrounding streets. Two outlets are to be constructed so that rain waters may be drained off to the normal level. At Nakamachi, the main sewer will be divided into two lines. The first will pass through Nakamachi to Manseibashi where surface waters will be discharged into the Kanda River and the second will carry the sewage to Kiridoshi Sakashita, thence to Shoheihashi, crossing under the Kanda River to Nishikicho Sanchome, then across the outer moat to connect with the Suidobata line. At Kanda Bashi it will join the Ushigome main, and pass in front of the Department of Finance and connect with the low level system. This line will follow along the main road through the palace outer grounds, then to the south and west of Hibiya Park, cross Shinsaiwai Bashi to Onari Mon, through Shiba Park to Shibazono Bashi cross the Furu River by Fudanotsuji discharging at the Shibaura collecting tanks.

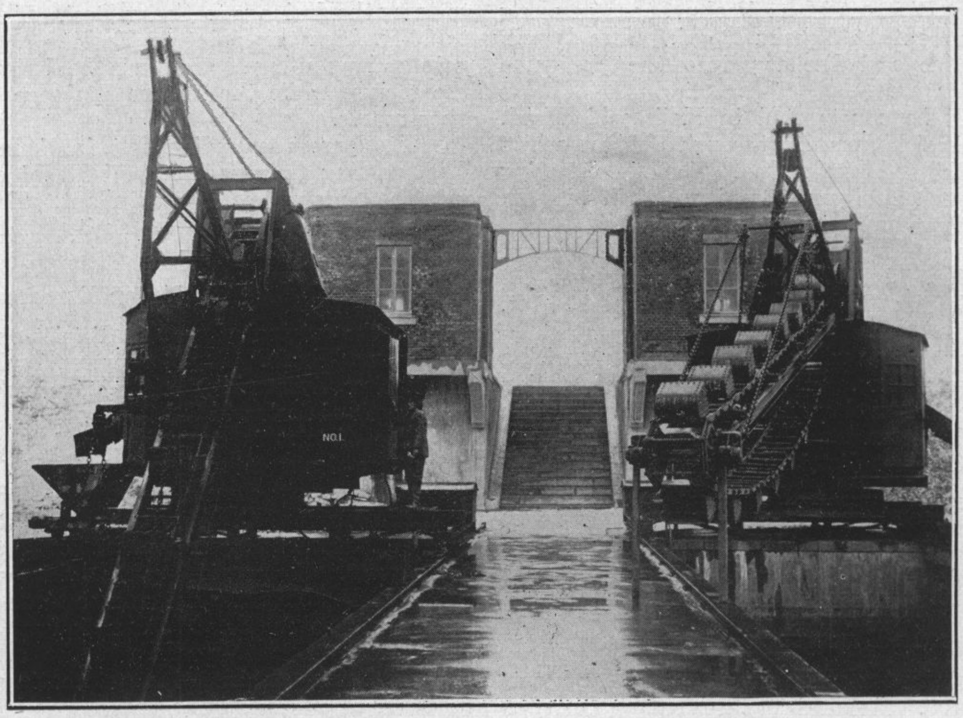
Shiba Ward.—Two branch lines will serve this district. The first will start at Shiba Rogetsu Cho, passing through Shin Senza Machi, and crossing the Furu River will connect at Shibazono Bashi with the mid-level system. Automatic valves will be employed to control the flow when the rainfall is heavy permitting its discharge into the bay at low tide and closing automatically at high tide.

The largest pipe in this district on the lower stream of the Sen River will have a width of 20-ft. and a depth of 9-ft. The second line from Shibazono Bashi to Shibaura will be box shaped, 11-ft. wide and 8-ft. 8-in. deep.

Sewage will be collected at the Shibaura pumping station, and after settling, pumped to the Rokugo disposal plant. The main pipe line at its greatest depth will be only 6-ft. 4.6-in. under the standard Reiganjima level.

Low Level Line.—This district includes the whole of Kyobashi (excluding Tsuki shima) a small part of Kanda and Kojimachi and the Edo River. The drainage area is 3,256,000 *tsubo*, calling for 801,000-ft. of sewers. This district is very low and flat and provision has been made for flushing the pipes from the water mains.

At low tide the storm waters can be easily disposed of, but with high tide or during heavy rains, the waters must be pumped off. The sewer pipes will be



Mikawajima Disposal Plant

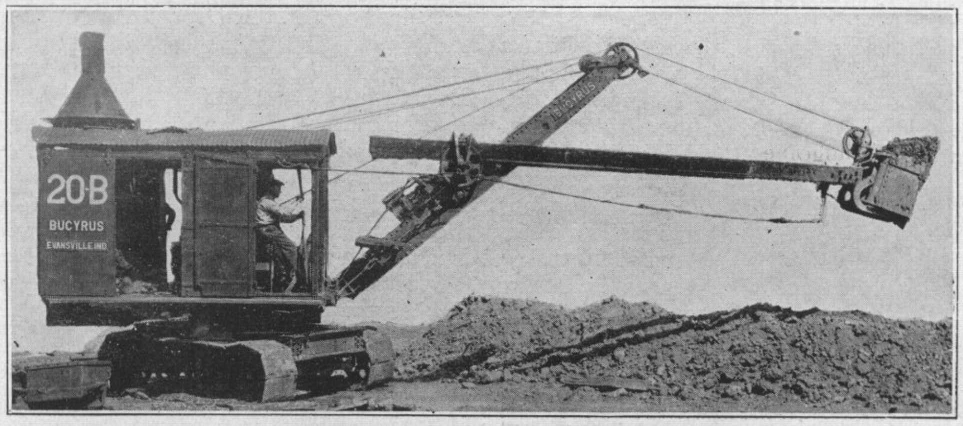
equipped with automatic valves to open and shut at low and high tides. All the sewage from this district will be collected at the Zengame pumping station where it will be raised and discharged into the Midlevel main.

Ushigome and Koishikawa.—A main will be constructed along the Edo River. Storm waters will be discharged direct into the river, and sewage conducted to Funakawara Bashi. Crossing the Edo River, it will connect with the Iidagashi line at Koishikawa Bashi and running along the outer moat will come out at Kanda Bashi and proceeding to Ryukan Bashi it will connect with the Kanda and Imagawa Bashi mains.

Motoshiro Cho in Kanda Ward is entirely surrounded by canals into which all the surface water and sewage has been discharged. A sewage drain will be laid from Iwamoto Cho to Kubo Bashi, thence to Jinbei Bashi and Ryukan Bashi where it will connect with the Kanda main. From there it will go to Tokiwa Bashi, and connect with a branch line coming from Nihonbashi, pass through Ise Machi and Muromachi and discharge into the Zenigame pumping station.

The main line from the Ginza in Kyobashi Ward will connect with one from Sukiya Bashi and Kiinokini Bashi at Minami Konya Cho. Surface waters will be discharged into the outer moat and rivers in this district. Crossing over the Eikuni Bashi this line will go to Gofuku Bashi where it will connect with the one from Kaiun Bashi.

Tsukiji.—Storm waters will be discharged into the canals and rivers and the sewage carried through branch lines to Shintomi Cho, then across the Kyobashi River, through Hatchobori Machi, to Matsuya Cho, connecting there with the Reiganjima line.



Bucyrus 20-A Ravolving Shovel—Equipped for Sewer Service 18-ft. Boom 24-ft. Handle ½ yd. Sewer Dipper

The Reiganjima line will start at Reiganjima Hama Cho, and connect with the Tsukiji line. The combined lines will go to Sakamoto Cho meeting another coming from Ryogoku Cho and Hama Cho. Surface waters will be discharged into the Sumida and Hamacho Rivers. This line will then cross the Hamacho and cross the Nihonbashi Rivers and connect with the Tsukiji and Reiganjima lines. The three combined lines will cross the Kaida River at Honzaimoku Cho, run along the Kaeda River and come out at Ikkoku Bashi. Here it will connect with the Ginza line and discharge into the Zenigame pumping station.

Two branch lines will be constructed in Kojimachi Ward. The first will start at Uchiwaicho, passing through Uchiyamashita Cho, Yuraku Cho, Yaesu Cho and Eiraku Cho. The other starting at Ote Machi passed through Zenigame Bashi, where it will join the first and discharge at the pumping station.

There will be no large sewers in this district. The maximum is of the horseshoe type 5-ft. 5-in. wide and 4-ft. 1-in. deep. At the deepest place near Gofuku Bashi, the bottom will be 8-ft. 1.5-in. below the Reiganjima level.

The Zenigame pumping station will handle sewage only with a very small quantity of storm waters. The sewage from this station will be discharged into the mid-level system at Ote Machi through an iron pipe 5-ft. 5-in. in diameter.

All the sewage from the first district will be collected at the Shibaura pumping station and freed of sediment. From here it will be pumped to Haneda, and then south through land to be reclaimed from Tokyo Bay to the mouth of the Rokugo River. This main of the horseshoe type will be 12-ft. wide and 9-ft. high with a gradient of 1 in 3,000.

Second District

The second district includes the entire Asakusa Ward, and parts of Shitaya, Kanda and Hongo. The drainage area covers 2,495,000 *tsubo*, with 588,000-ft. of mains and branches.

With the exception of Uyeno and the high lands of Hongo, this district is low and damp. In the lowest part at Senzoku Machi, on the banks of the Shinbori River, the drainage is exceptionally difficult. Ordinary rainfall raises the level of the Sumida River higher than the moats and canals carrying off the drainage, causing unsanitary and disagreeable flooding of the districts. This is also true of Shitaya Ward, whose main drainage canal, the Aizome River, frequently overflows with the surface waters from Hongo and Uyeno as a result of any considerable rainfall. To relieve this, a special sewer with a diameter of 10-ft. will be built from Shinobazu Pond to Manseibashi discharging into the Kanda River. All the surface drainage and sewage of this district will be collected in the same mains, the surface waters discharging into nearby streams at convenient points.

The population of this district is estimated at 600,000, with sewage requirements of 12 cu. ft. per capita a day. The sewage will be conducted through a main from the western end of Nakaokachi Machi and Matsunaga Cho. The Izumi pumping station will force it through to Shitaya, there discharging it into the Goryu Branch line. The main sewage line from Shitaya Okuchi Machi, passing through Nishimachi Takecho, will discharge direct into the Suga River. A covered moat starting at Fukutomi Cho will be constructed from Samisen Bori and passing through Torigoe Cho, Misujimachi Iriyachi and Ryusenji Machi will receive the accumulations of the branch lines and discharge at the Mikawajima disposal plant. All these branches are to be covered moats.

Surface waters will be discharged into the Sumida and Kanda Rivers and the Sanya Moat. A main pipe line will be constructed from north to south passing near the Honganji Temple. Here the sewage will be divided into two parts, the surplus rain waters from the south discharging through the Shin Bori into the Sumida River, at Kuramae Katamachi. An automatic valve will be installed at the outlet to keep out the tide waters.

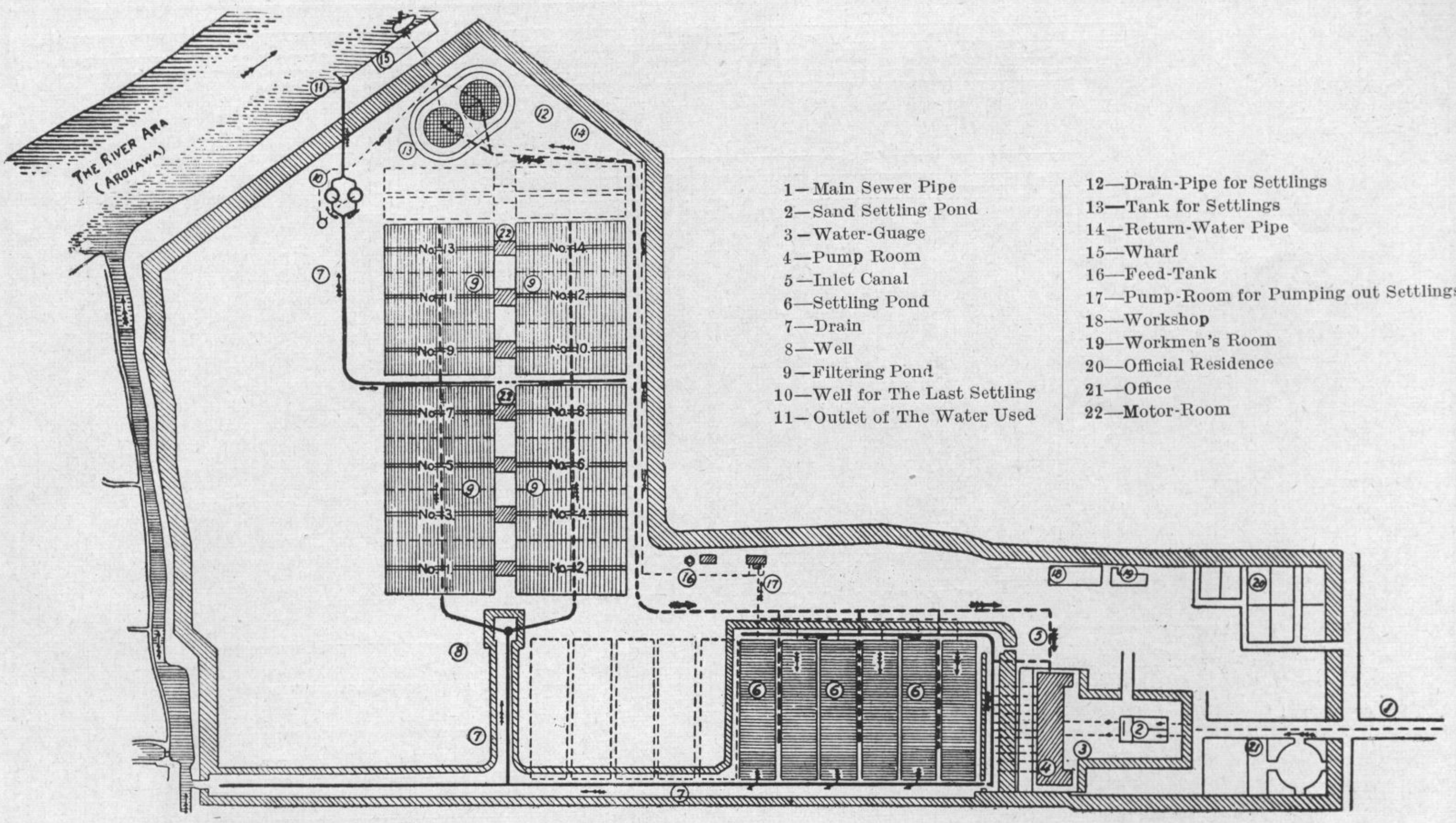
Drainage from the north will be carried through the existing moat to Kogetsu Cho and from here will pass through Tamachi where a new open moat 24-ft. wide will be built to carry the drainage to Sanya Bori. This stream is to be widened to 30-ft. from this point to Yoshino Bashi. An automatic water gate and pumping station will be built near Tamachi to handle the sewage while the surface drainage will be diverted into the open moats.

The largest sewer line, 9-ft. in diameter, will start at Kogetsu Cho, passing through Ryusenji Machi and Minoa and discharge into the Mikawajima disposal plant. The gradient is 1-2,000, and the bottom of the pipe line at its lowest point, 11-ft. below the Reiganjima standard.

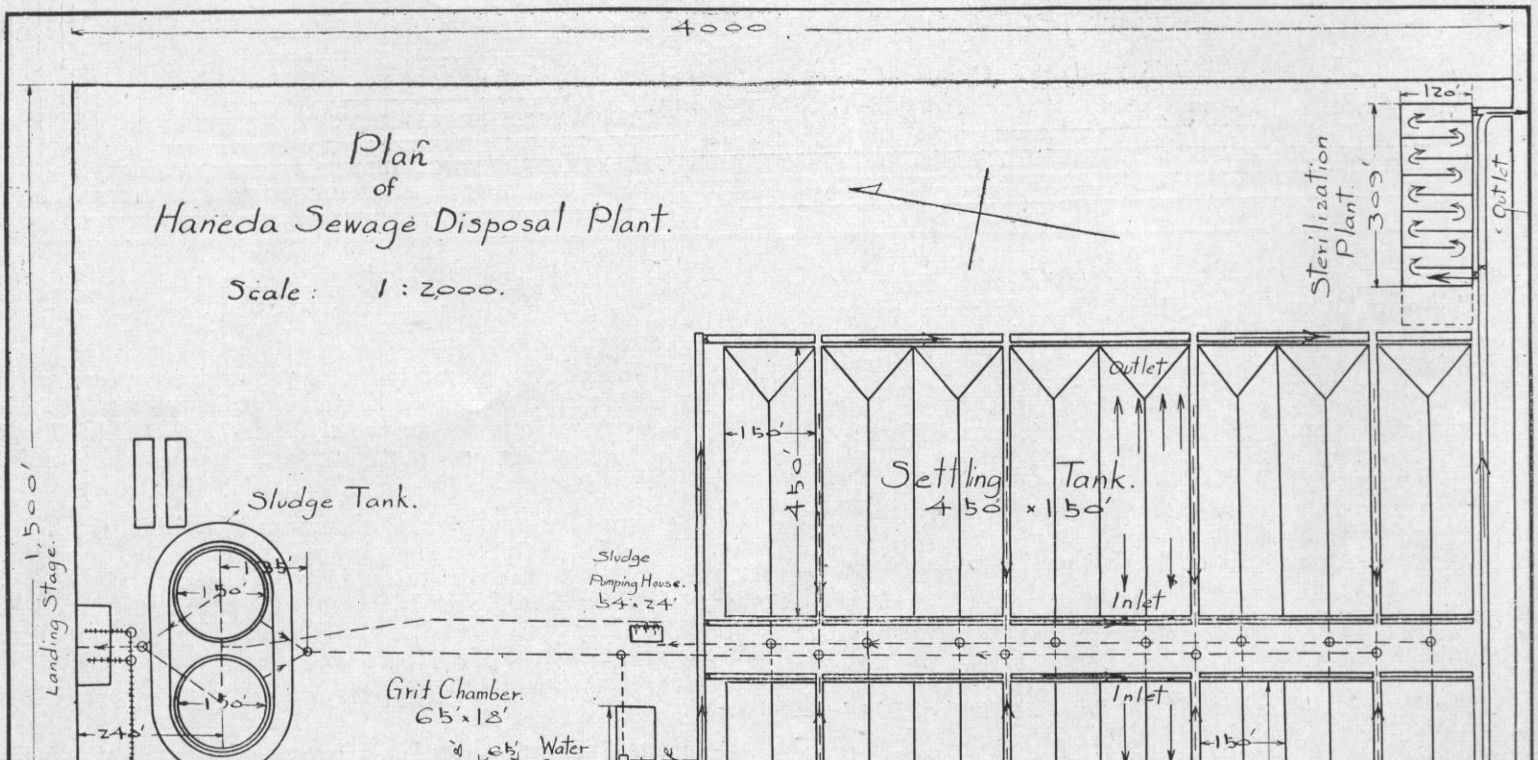
Third District

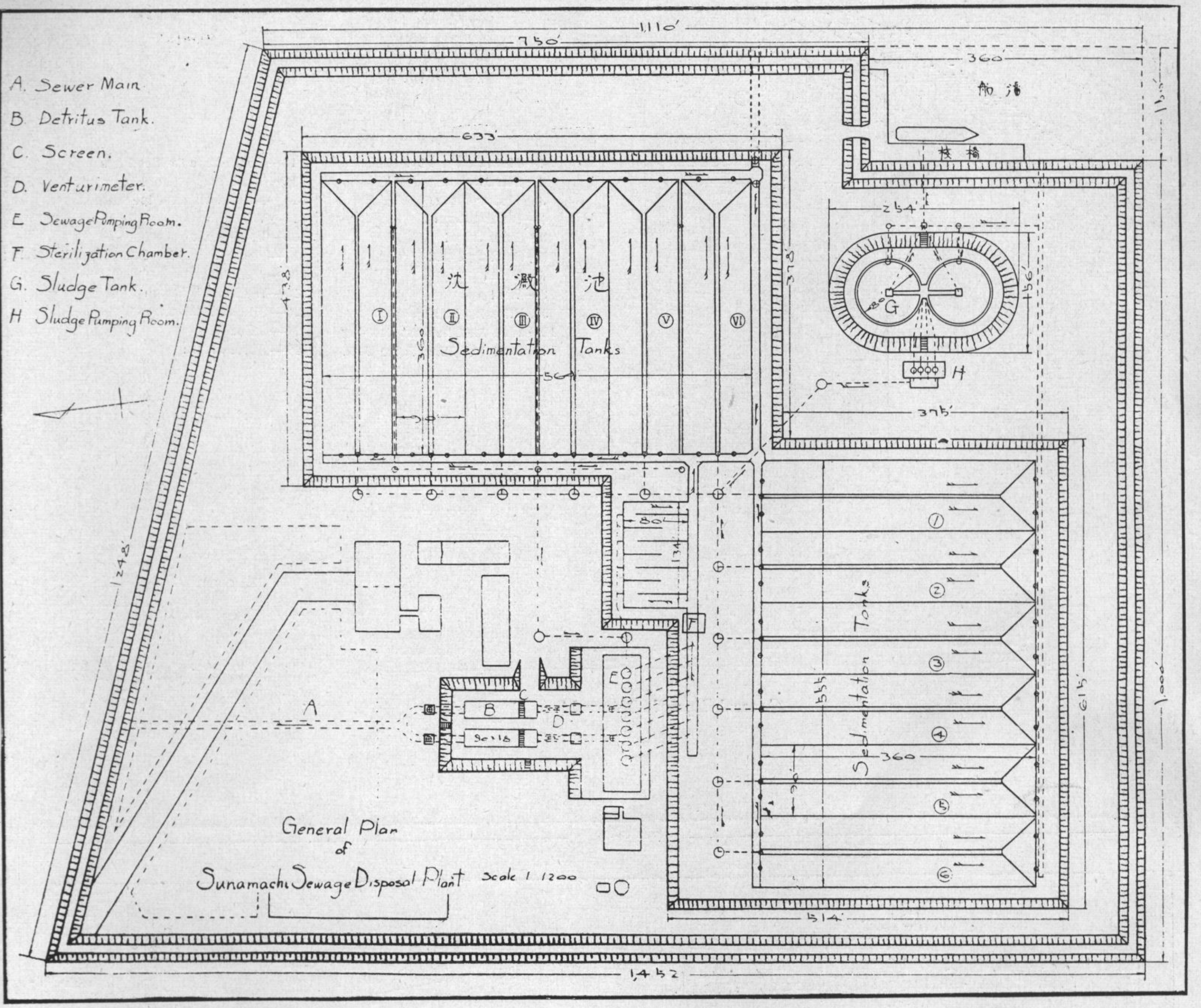
In the original plan, this district embraced all of Honjo and Fukagawa Wards. The Reconstruction Bureau has since included Tsukishima, increasing the drainage area to 3,787,000 *tsubo,* and the length of drains to 721,000-ft.

The district is exceptionally low and damp and with the exception of a small section it is impossible under ordinary conditions to properly expel the drainage and sewage. The high tide mark is about 7-ft. 5-in. above the Reiganjima standard level. These districts being below this level, the tide frequently floods the streets. To provide against this contingency, embankments raised 10-ft. above the Reiganjima standard are to be built with a water gate at the Koeda River to keep back the tide water and make it possible to pump out the accumulated storm waters. Supplementary drains with automatic water gates will be constructed throughout the district in order to permit the discharge of drainage at low tide. All gates will be closed at high tide and



General Plan of Mikawashima Disposal Plant





the drainage collected at the pumping stations until the next low tide. The pumping stations will handle both drainage and sewage discharging into the surrounding streams. The greater part of the sewage and a small part of the storm waters will be pumped to the disposal plant located in the bay near Nakagawa Hosuiro.

The third district has been subdivided into four sections :

(1) From Honjo, Yanagijima Machi, Tenjin Bashi, passing through Hoonji Bashi to Yokoami Cho 2 chome, to the north of the road.
(2) From the boundaries of the first section and north of the Onari River.
(3) South of Onagi River, including all Fukagawa Ward.
(4) Tsukishima.

FIRST SECTION.—*Narihira Bashi Pumping Station District.*—Includes the district bounded by the Kita Jikken and Oyoko Rivers : (1) Mukojima ; (2) Yanagijima and Oshiage district ; (3) Naganogo district.

A pumping station will be built at Narihira Bashi, to permit the accumulation of drainage to be expelled at all stages of the tide.

The main sewage and drainage line of this section will be :

(1) From Mukojima, Nakanogo Machi, Shichihon Matcu Bashi, along the North Bank of the Hikifune River ; crossing the Kita Jikken River to reach the pumping station.
(2) Surface drainage from the northern part will be carried along the line of the tramway, passing Oshiage Bashi to reach the pumping station.
(3) The main line of surface drainage from the southern parts of 1 and 2, will be concentrated at Matsukura Machi 2 chome, passing to the north will reach Hachiken Cho 2 chome, joining the drainage from the northern part of the second section.

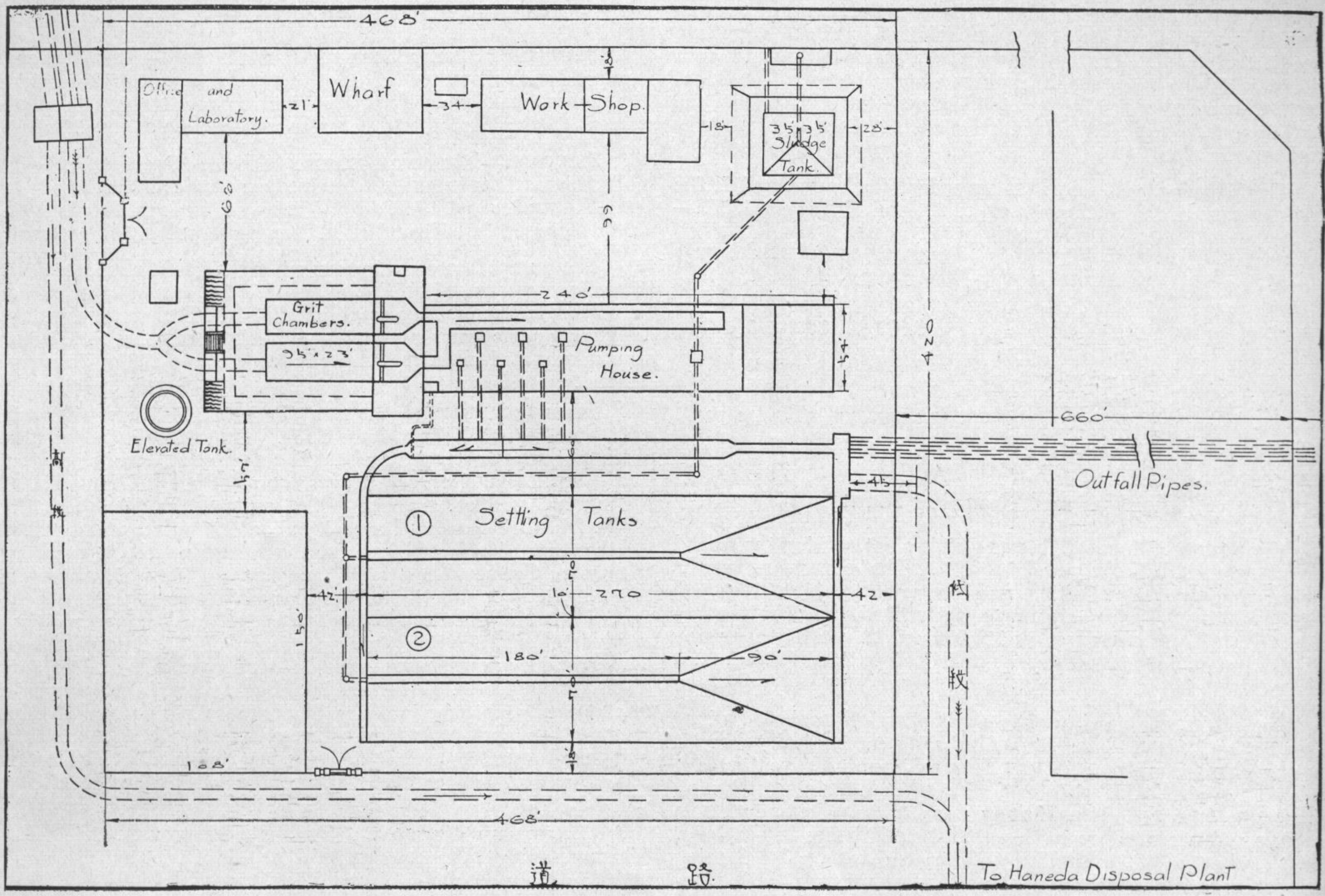
The largest drain will be of the horseshoe type, 14-ft. wide, 8-ft., 4-in. high. The bottom of the pipe will be 8-ft. 7-in. below the Reiganjima level. Surface waters from this district will be discharged into the Kita Jikken River while the sewage will be raised by special pumps and carried to the Sannohashi pumping station. The maximum volume of surface water is estimated at 800 cu. ft. per second, and the maximum volume of sewage at 33 cu. ft. per second.

SECOND SECTION.—*Sannohashi Pumping Station District.*—This section is divided by the Tae and Oyoko Rivers into four sub-sections : (1) Kinshi Cho ; (2) Midori Cho ; (3) Sarue Ura Machi ; (4) Kikugawa Machi and Morishita Cho.

A pumping station is to be erected at Tokuemon Cho near Sannohashi.

The main sewage and drainage lines of this section are :

(1) Start at Yoshida Machi, receive sewage coming from Narihira Bashi pumping station, then turning to the south



Plan of the Shibaura Pumping Station

it will join the main from the first and second sub-sections at Kasamatsu Cho and Hama Cho. Crossing the Tate River will discharge into the pumping station.

(2) From Fukagawa (Honnura Cho) will meet the line from the north half of the third sub-section, and crossing the Oyoko River will discharge into the pumping station.

(3) From Fukagawa (Rokkenbori Kitanohashi) collecting from the southern part of the fourth sub-section, will pass the Tokuemon station and join the line from the southern part of the third sub-section, and connecting with another line from the northern part of the fourth sub-section, will discharge into the pumping station.

The largest drain will be horseshoe shape, 18-ft. wide, 10-ft. 8-in. high. The bottom of the pipe at its greatest depth will be 10-ft. 6-in. under the Reiganjima standard level. The maximum volume of surface water is estimated at 1,100 cu. ft. per second; of sewage, 75 cu. ft. per second.

The main sewer from this section will pass through Kikugawa Cho, Tomikawa Cho, and passing to the south cross the Onagi River to Higashi Daiku Machi, and join the main line from the third section.

Third Section.—*Kiba Pumping Station District.*—This section is divided into five sub-sections:

1. East of the Oyoko River, Nijikken River, both North and South, and the vicinity of Senda Machi.
2. Ogibashi Machi, Reigan Machi vicinity, East of Oyoko River, and North of Sendaibori River.
3. Vicinity of Hirai Machi, East of Oyoko River and South of Nijikken River.
4. Vicinity of Kibe Cho, West of Oyoko River, South of Sendaibori River, and East of Naka River.
5. Kuroe Cho Furuishiba Machi, West of Naka River, and South of Sendaibori River.

The pumping station will be located at Ogi Machi, near Suehiro Bashi.

The main sewage and drainage lines are:

1. Starting at Higashi Daiku Machi, Irifune Bashi, will join the line which comes from Sannohashi and proceeding to the South, connecting on the way with several lines from other sections, will cross Sendaibori to the pumping station.
2. Starting at Etchujima Machi, joins the sewage line from Tsukishima, passing through Shioami Bashi to Kiba Machi (2 banchi, seashore), where the sewage from the third section is received. It then joins the main line coming from the East and turning to the North discharges into the line from the fourth section and flows to the pumping station.

The largest drain is 18-ft. wide, 10-ft. 8-in. deep, with the bottom of pipe at its lowest point 10-ft. 4-in. under Reiganjima standard level. The pumping station covering an area of 3,900 *tsubo* will be the same as the others. A power generating station will, however, be added to the other equipment. The maximum drainage discharge is estimated at 900 cu. ft., per second and maximum sewage discharge at 150 cu. ft. per second. The pumping station in this third section will collect all the sewage and discharge into the Sunamachi disposal plant.

Fourth Section.—*Tsukishima.*—Tsukishima is somewhat higher than other parts of the third district, and its drainage presents no special problem. The main sewer starting at Shin Tsukishima Bashi and laid under the Nijikken Road will discharge into a small pumping station at Hatsumi Bashi, which will force it through an iron pipe crossing the Aioi bridge to connect with the main line from the Kiba pumping station.

The main sewage line from Kiba to Sunamachi is to be 9-ft. wide, 6-ft. 3-in. high, horsehoe type. It will follow along the Nijikken River and south shore of Sunamachi canal, thence turn

eastward and at the north side of Hachiman shrine will turn to the South, parallel the Ara River embankment, and discharge into the disposal plant. The bottom of the pipe at its lowestd epth will be 5-ft. 9-in. below the Reiganjima standard level. The Sunamachi disposal plant is designed to handle all the sewage from the third district. It will be built on reclaimed land out in the bay at Arakawa Hosuino.

The following table shows the expenditure on sewers and drains from the time of the earthquake up to the end of August, 1924 :—

Year		Estimated Costs of Construction	Payments to end of August, 1924	Percentage of total completed
1923-24	...	Y.1,500,000	Y.882,252.89	58.8%
1924-25	...	9,400,000, plus surplus from previous year Y.617,747.11	Y.1,906,036.09	21.1%
Total	...	9,900,000	Y.2,788,288.98	28.1%

Disposal and Pumping Plants

MIKAWAJIMA DISPOSAL PLANT.—This plant, serving the second sewage district was completed in 1922. The disposal process is carried out by sedimentation and bacterial treatment through trickling filters. The maximum capacity of the present plant is 165 cubic feet per second or 14,256,000 cu. ft. per day for rainy weather, while the normal dry weather load is 2,760,000 cu. ft. a day.

The equipment consists of two grit chambers each 65-ft. long and 18-ft. wide and 17-ft. deep, filled with mechanically scraped racks. There are six horizontal flow sedimentation tanks, each 280-ft. long, 70-ft. wide with 68 of effective depth, sixteen trickling filter units equipped with Hartley Sons & Co. (Stoke-on-Trent) travelling distributers are installed, each unit being 220-ft. long, 100-ft. wide and 6-ft. deep filled with broken stone. The filtering area covers nearly seven acres with a total volume of filtering medium of 1,850,000 cu. ft. The pumping house is equipped with six motor driven centrifugal pumps (16-in.-22-in. and 30-in. diameter). There are also two final settling (25-ft. diameter, 24-ft. deep) tanks and two sludge storage tanks of 72-ft. diameter with an efficient depth of 8-ft.

SUNAMACHI DISPOSAL PLANT.—This plant, handling the refuse of the third district will be erected on reclaimed land in Tokyo Bay some distance off the foreshore and have a maximum rainy weather capacity of 12,960,000 cubic feet per day or 150 cu. ft. per second (4,200,000 cu. ft. per day) in normal or dry weather.

The pumping house will be equipped with seven motor driven centrifugal pumps, 16-in. to 32-in. diameter, with a total capacity of 195 cubic feet per second. There will be two grit chambers each 90-ft. long, 18-ft. wide and 8.5-ft. of effective depth, fitted with mechanically scraped racks. The purification battery consists of twelve horizontal flow sedimentation tanks each 360-ft. long 90-ft. wide and 8-ft. effective depth, six of which are sufficient to handle the normal discharge from the district, the whole battery being operated only during rainy weather.

The disinfection process will be carried out in three sedimentation tanks, grit chambers and one sludge tank. This part of the plant will be built first. There will also be two circular sludge storage tanks of 80-ft. diameter and 14-ft. depth each.

HANEDA DISPOSAL PLANT.—The disposal process at this plant will be plain sedimentation and disinfecting, the installation to consist of four grit chambers 100-ft. long, 18-ft. wide and 16-ft. deep, fitted with cage screens ; 16 horizontal flow sedimentation tanks, each 450-ft. long, 150-ft. wide and 7½-ft. effective depth, of which only half will be in use during dry weather. There will also be two circular sludge storage tanks 150 ft. diameter each, with a total height of 27½-ft. and 12-ft. effective depth and disinfecting equipment. The capacity of the plant will be 12,800,000 cu. ft. per day in dry weather and 405 cu. ft. per second (34,992,000 cu. ft. per day) in wet weather. The pump house installation will consist of ten motor driven centrifugal pumps, 16-in. to 32-in. diameter with a total capacity of 420 cu. ft. per second.

Pumping Stations

TAMACHI PUMPING STATION (Constructed).—This station is equipped with six motor driven centrifugal pumps of 45 1-in. diameter having a total capacity of 600 cubic feet per second. The intake tank is of simple reinforced concrete construction filled with racks.

ZENIGAME PUMPING STATION (Under Construction).—The collecting basin or intake of reinforced concrete construction is 40-ft. long, 20-ft. wide and 25-ft. deep. There are two grit chambers each 130-ft. long, 15-ft. wide and 12-ft. deep, equipped with wing screens.

The pumps house equipment will consist of five motor driven centrifugal pumps, of which two are of 32-in., two of 24-in. and one of 16-in. diameter, with a total lift of 25-ft. Their total capacity is about 114 cubic feet per second. A further extension to this plant is contemplated in order to raise its capacity to 158 cubic feet per second.

SHIBAURA PUMPING STATION (Projected).—There will be two grit chambers each 95-ft. long, 23-ft. wide and 17½-ft. deep, fitted with mechnically scraped racks. The pump house will be equipped with six motor driven centrifugal pumps of which three will be of 30-in., two of 16-in. and one of 24-in. diameter. The total lift is 22-ft. and their combined capacity about 150 cu. ft. per second. A further extension is provided for that will increase the number of pumps to twelve with a total capacity of 330 cu. ft. per second. Pending the construction of the Haneda disposal plant, the Shibaura pumping station will be equipped with a temporary disposal equipment of two sedimentation tanks each 270-ft. long, 70-ft. wide and 7-ft. deep ; one sludge tank 35-ft. square and 10-ft. deep and a disinfecting process. When the Haneda disposal plant is completed, the sewage emptying into the Shibaura collecting tanks will be pumped up and carried away by gravity to Haneda through a reinforced concrete conduit of horseshoe shape (12-ft. by 9.6-ft.). The length of this conduit will be 35,000-ft. with a gradient of 1-3,000.

HONJO AND FUKUGAWA PUMPING STATIONS (Projected).—Three pumping stations are planned for this district to be located at Narahirabashi, Sannohashi and Kiba.

The Narahirabashi plant will be equipped with four grit chambers with mechanically scraped racks, each 100-ft. long, 15-ft. wide and 22-ft. deep. The initial pumping equipment will consist of one 48-in. diameter centrifugal pump with a lift of 10-ft. and 400 cu. ft. capacity per second for storm waters and one 20-in. and two 12-in. diameter pumps with a total of 27 cu. ft. per second capacity and lift of 18-ft. for sewage, giving a total of 427 cu. ft. per second. Provision is made for doubling the capacity of this station to 843 cu. ft. per second by the addition one 48-in. storm water pump and one 20-in. pump for sewage.

The Sannahasi pumping station will be equipped with four mechanically scraped grit chambers each 100-ft. long, 20-ft. wide and 24½-ft. deep. The initial pumping installation for storm waters will consist of four 52½-in. centrifugal pumps with a lift of 10-ft. and 640 cu. ft. capacity per second. For sewage there will be two 24-in. diameter pumps with a capacity of 50 cu. ft. per second with a lift of 18-ft. and two 18-in. pumps of 24 cu. ft. capacity, a total capacity of 714 cu. ft. per second. Provision is also made to expand this capacity to 1,219 cu. ft. per second by the addition of three 52½-in. storm water pumps and one 24-in. sewage pump.

The Kiba pumping station will have four mechanically scraped grit chambers each 100-ft. long, 16-ft. wide and 27-ft. deep, with an initial pumping equipment of four 51-in. diameter storm water pumps with a total capacity of 600 cu. ft. per second and lift of 10-ft. Sewage will be handled by one 32-in. (50 cu. ft. per second) two 24-in. (50 cu. ft. per second) and one 16-in. (10 cu. ft. p.s.) giving a total capacity of 710 cu. ft. per second. Provision is also made to increase the capacity of this station to 1,085 cu. ft. per second by the addition of two 51-in. storm water pumps giving a total storm water capacity of 900 cu. ft. per second and one 32-in. and one 24-in. pump for sewage. A power plant of 3,600 k.w. capacity will also be added to the Kiba pumping station.

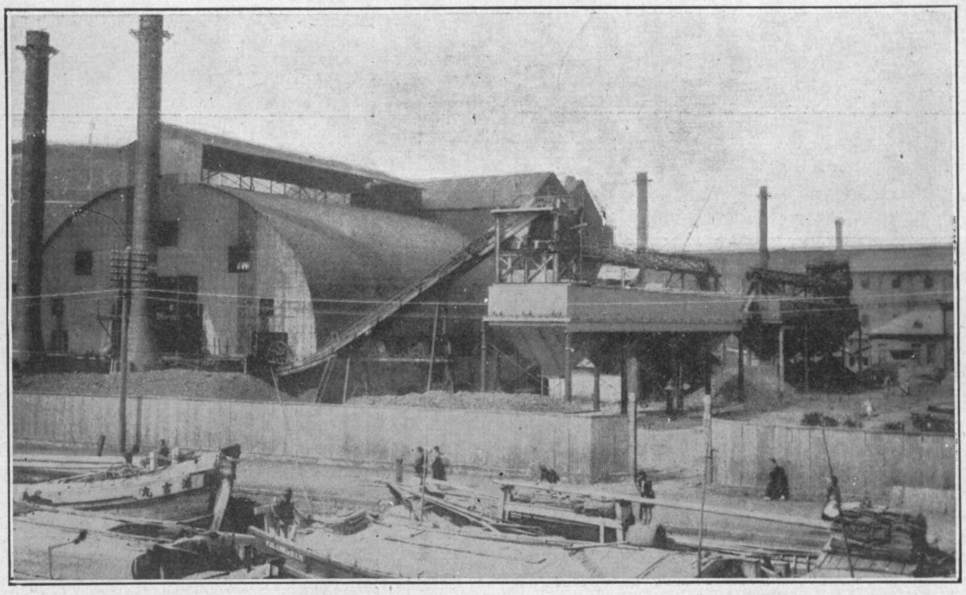
The sediment from all disposal plants and pumping stations after a brief storage in the sludge tanks is to be loaded into specially constructed sludge barges and discharged into the sea at a suitable distance from Tokyo.

Gas Supply of Tokyo

The Tokyo Gas Company

THE gas supply of Tokyo is a monopoly of the Tokyo Gas Company. The first gas works in the capital was operated by the Tokyo Prefectural Gas Department which was handed over to a private company headed by Baron Eiichi Shibusawa in 1885. The original small plant at Shiba, devoted exclusively to the manufacture of gas, has been developed with the growth of the city until at the time of the earthquake the company was operating five manufacturing stations, two by-product plants and one gas meter manufacturing and repair plant. In 1892, the Senju Works were erected, followed four years later by the Fukagawa Works. In 1901 a coal tar distillery and in 1905 a factory for making gas meters and appliances was added. The Omori Works was erected in 1910 and the same year the company purchased the coke plant of the Furukawa Mining Company and in 1912 acquired the works of the Chiyoda Gas Company, which was amalgamated to Tokyo Gas Co. Pipe lines were extended to all parts of the city and improvements made in manufacturing so that at the time of the disaster, the company was supplying 250,989 customers at a price equivalent to $1.08 gold per thousand cubic feet.

Before the earthquake, the aggregate daily output of these plants was about 25,000,000 cubic feet. Various types of retorts were in use, including two installations of vertical retorts, one of 2,000,000 cub. ft. per day at the Shiba Works and one of 1,500,000 cub. ft. per day at the Fukagawa Works. Horizontal retorts were in use in only one of the five gas works at Senju, where the capacity of the installation was 3,500,000 cub. ft. per day. At the Senju Works there were also inclined retorts having a capacity of about 2,000,000 cub. ft. per day. The carbonizing plant at the Fukugawa Works included an installation of inclined retorts capable of producing something like 4,500,000 cub. ft. per day. There are also two water gas plants, each of a capacity of 3,000,000 cub. ft. per day—one at the Fukagawa Works and the other at the Senju Works. At the Omori Works there was a battery of Koppers Coke Ovens having a daily capacity of 3,000,000 cub. ft. per day and at the Sunamachi Works a similar battery with a capacity of about 1,000,000 cub. ft. The by-products plant produced about 2,000 tons of tar per month.



Fukagawa Plant of the Tokyo Gas Company

The damage done to the plants by the earthquake was extensive, but the total loss did not exceed Y.5,600,000 which has since been offset by the enhanced rise in value of the other properties. The greatest blow to the company consisted in the loss of over 110,000 customers whose houses were destroyed. The coke ovens at the Omori Works were almost completely destroyed, but they are now undergoing repairs and reconstruction. The vertical retorts at the Shiba Works and the coal washing plant at Sunamachi and some of the machine houses, store houses and offices were so seriously damaged by fire as to be rendered useless. The company's head office and many of its branch offices were totally destroyed by fire. Fortunately, the damage done to the Fukagawa and the Senju Works was comparatively slight and within a fortnight all necessary repairs were effected. One of the by-products works was involved in the general conflagration which resulted in the complete loss of all the coal tar, pitch and oil stocks. These works were however completely rebuilt in three months and able to resume their normal output.

Immediately after the earthquake all manufacturing operations and distribution of gas was suspended and all gas holders emptied, but in spite of every precaution that could be taken, a few of the mains exploded in various parts of the city. Nearly all the joints carried over the river bridges were broken, though for the most part, the joints of the underground pipes were not so severely damaged.

Some idea of the extent of the damage done to the distribution side of the undertaking may be gathered from the fact that of the 250,989 gas meters in use at Tokyo at the time of the earthquake, 112,588 were destroyed. The total damage, as mentioned above, approximates Y.5,600,000, but it will be necessary to spend three times that amount in order to bring the works of the company into full working order and make them adequate to meet the needs of the future.

The gas supply to Tokyo was resumed within three weeks after the disaster and by the end of October the company was supplying 12,000,000 cub. ft. per day—about half the normal output. By the end of 1923, the whole of the distribution system in the unburnt districts was completely repaired and in good working order while the mains and pipes in the burned districts were largely relaid during the first half of 1924.

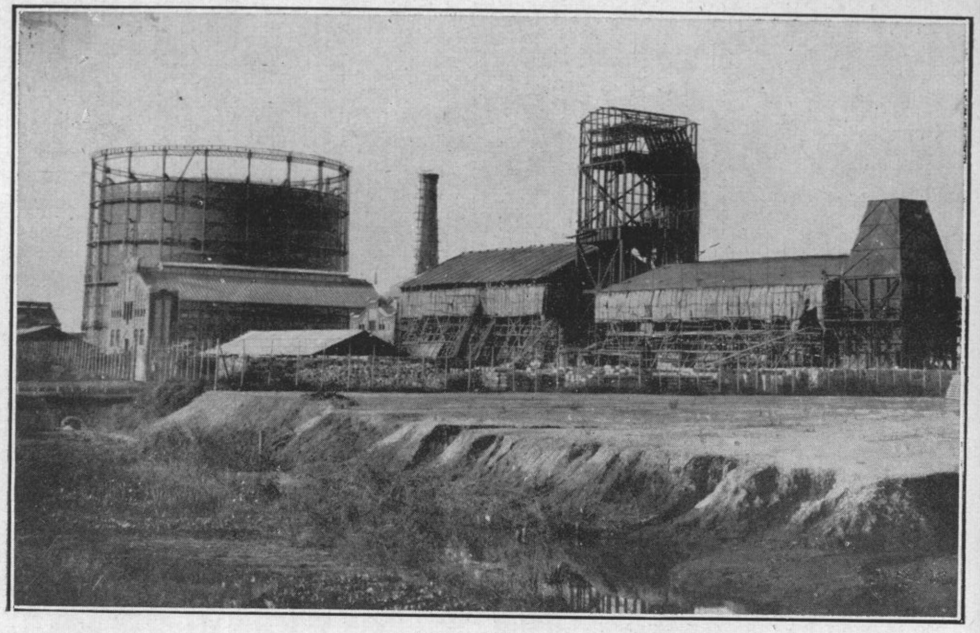
At the present time, the company is purchasing gas in bulk from the Kanagawa Coke Company, which operates a plant a few miles from Tokyo, enabling it to maintain a supply which varies from 16,000,000 cub. ft. per day in summer to 24,000,000 cub. ft. per day in winter. Considerable new equipment has been installed, including vertical retorts of the Glover-West type (manufactured in Japan) at the Shiba Works of 3,000,000 cub. ft. capacity per day and horizontal retorts of 1,000,000 cub. ft., and a water gas plant of 3,000,000 cub. ft. capacity at the Omori Works.

The Tokyo Gas Company has every reason to look forward to a most prosperous future as the demand for gas is constantly increasing and the use of gas appliances becoming more and more popular. A large and increasing demand is being felt for gas heaters and although the employment of gas engines as prime movers has been displaced by the electric motor this is being offset by an increasing demand for gas in industrial plants. The largest purchaser of gas for manufacturing purposes is the Asahi Glass Company, whose great plant near Tsurumi consumes from 200,000 to 300,000 cub. ft. daily.

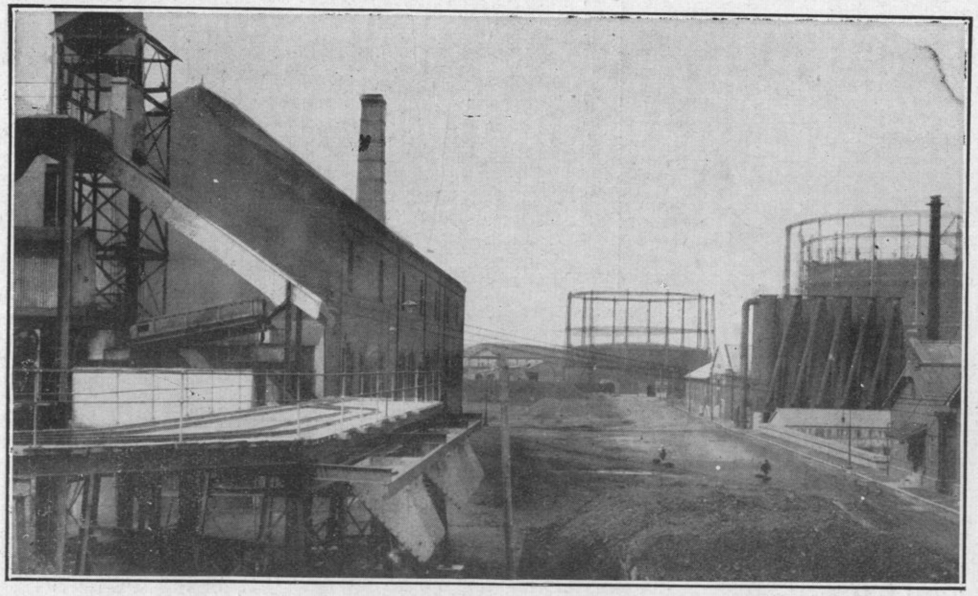
The extensions to the Omori plant include the installation of coke ovens of 4,000,000 cub. ft. capacity to be completed by the end of the present year. This is to be followed next year by another similar plant of equal capacity. On the completion of the Omori plant, the Senju Works are to be enlarged, followed by the erection

PRINCIPAL PLANTS OF THE TOKYO GAS COMPANY

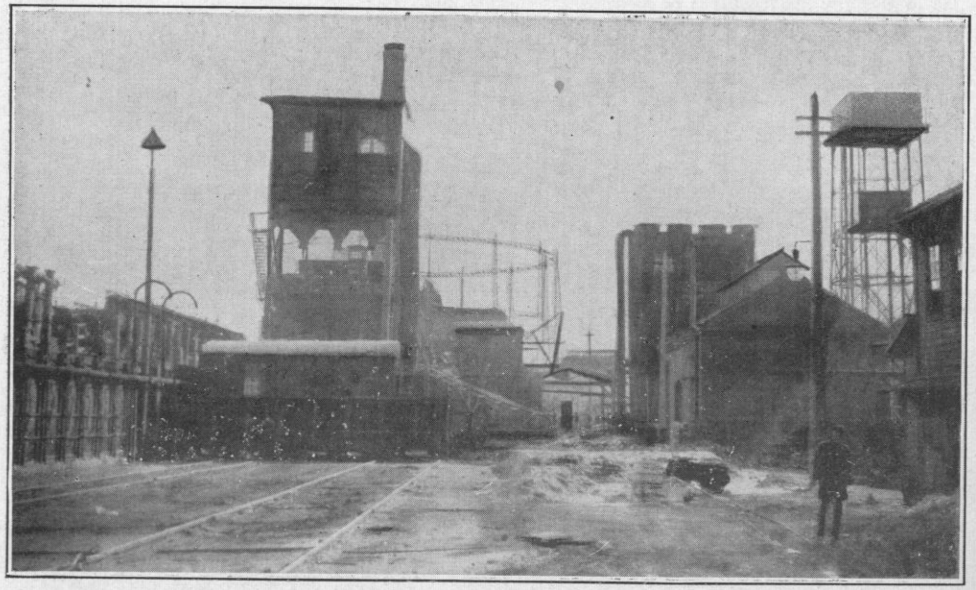
Shiba No. 2 Plant



Omori Plant



Senju Plant



Sunamura Plant

of another new works for which the company is at present selecting suitable ground in the environs of Tokyo. A 3,000,000 cub. ft. holder tank with all accessories and equipment is now under erection at Meguro and will be completed by the end of next year. The plans of the company contemplate a supply of 60,000,000 cub. ft. within seven years, calling for additional equipment to manufacture 32,000,000 cub. ft. In order to carry out this great expansion program, the capital of the company will be increased from Y.45,000,000 to Y.90,000,000.

The present capital of the company is Y.45,000,000 divided into 900,000 shares, all paid up, with outstanding debentures of Y.8,000,000 at 8 per cent. The latest dividends were nine per cent. per annum.

Equipment of Plants

SENJU GAS WORKS: Horizontal and inclined type retorts and water gas plant with a capacity of 9,000,000 c.ft. daily.

FUKAGAWA GAS WORKS: Vertical and inclined retorts with water gas plant 9,000,000 cub. ft. of gas per day.

SHIBA GAS WORKS: Vertical type retorts, 3,000,000 c.ft. gas daily.

OMORI GAS WORKS: Before the earthquake this plant was equipped with Koppers Type Coke Ovens. It was almost entirely destroyed and is now being reconstructed by new design. Present capacity is 3,500,000 cub. ft. daily by horizontal retort and water gas plant.

SUNAMACHI GAS WORKS: Koppers Type Coke Ovens, 1,000,000 c.ft. capacity daily. The plant is producing hard coke.

OSHIMA SEISEIJO: By-products works distilling tar from gas works with a sulphate of ammonia plant and chemical plant.

SARUE BRANCH FACTORY: Distilling 60 to 70 tons of tar per day.

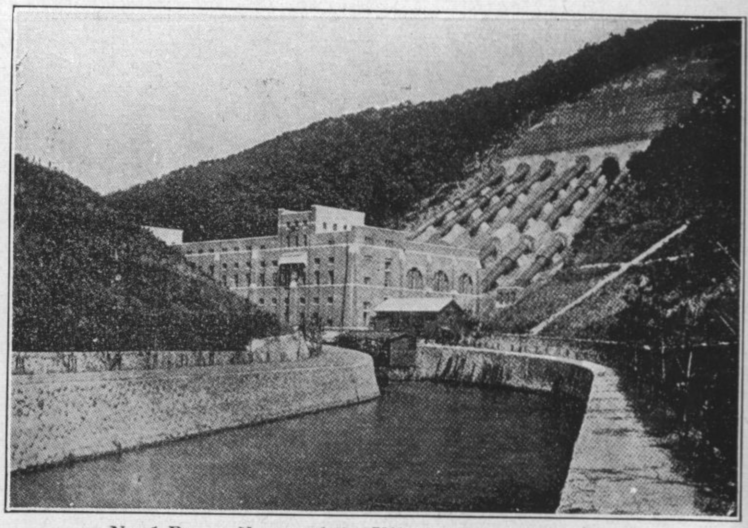
OTHER FACTORIES: Gas meter, repair and appliance works. Stock storehouses, inspection and repair shops.

GAS HOLDERS: The Senju Works has three holders, with the following capacities, 3,500,000 cub. ft. 1,000,000 cub. ft. and 500,000 cub. ft. The Fukagawa Works has two, one of 1,000,000 and the other of 600,000 cub. ft. capacity. The Shiba Works has two holders one of 3,000,000 cub. ft. and the other of 1,000,000 cub. ft. The Omori Works has one holder of 3,000,000 cub. ft. and the Sunamachi Works one holder of 600,000 cub. ft. capacity. In addition, there are three gas holder stations one at Yodobashi of 3,000,000 cub. ft., one at Takinogawa of 3,000,000 cub. ft. and one at Kawasaki of 50,000 cub. ft.

GAS MAINS: At the present time there are over 75 miles of high pressure mains, with 980 miles of low pressure lines of above three inches diameter and 685 miles of $2\frac{1}{2}$-in. or less. Over 285,000 house connections are laid, but at present only 216,000 houses are being supplied.

A few particulars as to the type of plant in use and the output and prices charged for gas in Japan will be of interest as showing the favorable position of the Tokyo Gas Company as compared with other Japanese gas undertakings. The maximum output from the five works of the Tokyo company at the present time is about 25, 000,000 cub. ft. per day, and the price is Yen 2.60 (par value equivalent) per thousand c.ft. in Tokyo, and from Yen 3.50 in the outlying districts.

The Osaka Gas Company has a works with a carbonizing capacity of 8,000,000 cub. ft. per day. Here horizontal retorts are used, and in addition to these there is a water gas plant and a battery of chamber ovens. The price of gas is Yen 3 per thousand feet. Horizontal retorts are used exclusively for carbonizing at the Kyoto Gas Works, where it is possible to meet a demand for 3,000,000 cub. ft. of gas per day. Here the price of gas is Yen 3 per thousand feet. At Kobe, there are two gas works, which together are capable of producing over 5,000,000 cub. ft. per day. The carbonizing plant consists of horizontal retorts and a tully plant. The price of gas is Yen 3.75 per thousand. The Tokyo Gas Company owns four gas works giving an aggregate output of nearly 4,000,000 cub. ft. per day. Both vertical and horizontal retorts are in use and there are also some coke ovens. This company supplies a fairly wide area and the prices charged vary from Yen 2.75 to Yen 4.50 per thousand feet. The Hiroshima Gas and Electric Company operates four works with horizontal retorts and coke ovens. The daily capacity of these four works is about 1,500,000 cub. ft. The price of gas varies between Yen 2.75 and Yen 4.50. Horizontal retorts are used by the Saibugodo Gas Company, the Northern Kyushu Gas Company and the Hokkai Gas Company. The prices charged by these three companies are Yen 2.75 to Yen 3.50 per thousand.



No. 1 Power House of the Ujigawa Electric Company

Vast Field for American Capital

Ujigawa Issue Suggests Broader Market for Mortgage Bonds of Foreign Power Companies.

COMMENTING on the offering of $14,000,000 mortgage bonds for the Ujigawa Electric Power Company, one of the largest hydro-electric power companies in Japan, *The Sun* (N.Y.) calls attention to a vast field for the profitable employment of American capital.

New York bankers, says *The Sun,* have merely scratched the surface of the world's capital requirements for developing the power and light industry. Bonds secured by the property and earning power of power companies serving large and growing territories abroad are likely to find a broader market here than industrial issues, for American investors have learned to appreciate the strength that stability of earning power imparts to securities.

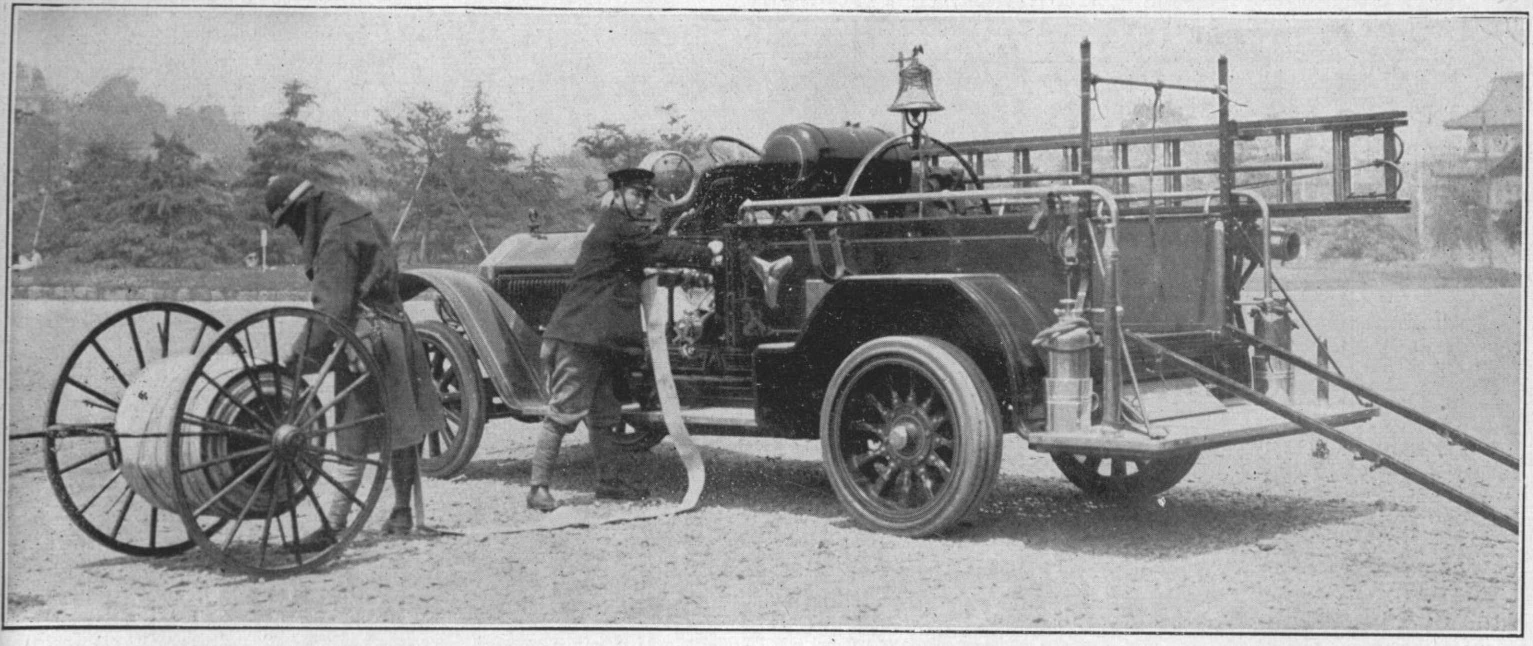
The Ujigawa Electric issue, offered in New York last April at a price to yield 7.90 per cent. to maturity in 1945, represents the third important piece of power financing done for Japanese companies in the American market. The attitude of the Japanese Government on external borrowings by Japanese corporations can be interpreted favorably for this and any other loan with Japanese property and earnings as security.

Because yen exchange is quoted at a discount of about 17 per cent. in terms of dollars, Japan is anxious to avoid the creation of debts abroad that will call for a constant exportation of capital to pay interest. Such interest payments would count in Japan's foreign trade balance sheet the same as importation of goods. They would require the purchase of dollar exchange.

Japan makes an exception, however, of loans for productive purposes. Sanction is given where it is manifest that the wealth to be created at home through a loan counterbalances the ill effect of capital exportation for interest. It can be assumed, therefore, that when a loan is approved the borrowers and the Government see their way clear to make the money earn its cost by a good margin. The Japanese power loans therefore start out without any question as to economic merit.

There is still another feature of Japanese corporation loans that gives them an unusual standing. All mortgages are "closed," not by agreement between borrower and lender, but because the laws do not permit any other kind of mortgage. All loans are secured by specific property, either all or just part of a company's plants. The mortgage cannot be increased in amount. In the case of the Ujigawa loan the earnings for 1924 were 3.2 times interest charges on the mortgage bonds.

A long-established American power company having the capital structure and earning power of the Ujigawa could borrow money at home on a first mortgage, on a $5\frac{1}{2}$ per cent. basis or better. Japan is a long way off and it is difficult for an American investor to visualize the borrowing company's property and field. Furthermore, our investors are not yet educated up to the general idea of foreign investments. With all its wealth and surplus capital, America presents a relatively small market for foreign corporation bonds. This condition and state of mind account for a large part of yield disparity as between domestic and foreign corporation bonds.



One of the American-La France 75 H.P. Motor Fire Engines on duty at the Headquarters Station of the Tokyo Fire Department

Modernizing Tokyo's Antiquated Fire-Fighting Methods

FIRE has always been one of the greatest menaces to life and property in the city of Tokyo, the paper and wood construction of buildings, open braziers for heating, and congested districts all contributing to a fire hazard greater than in most large cities of the world.

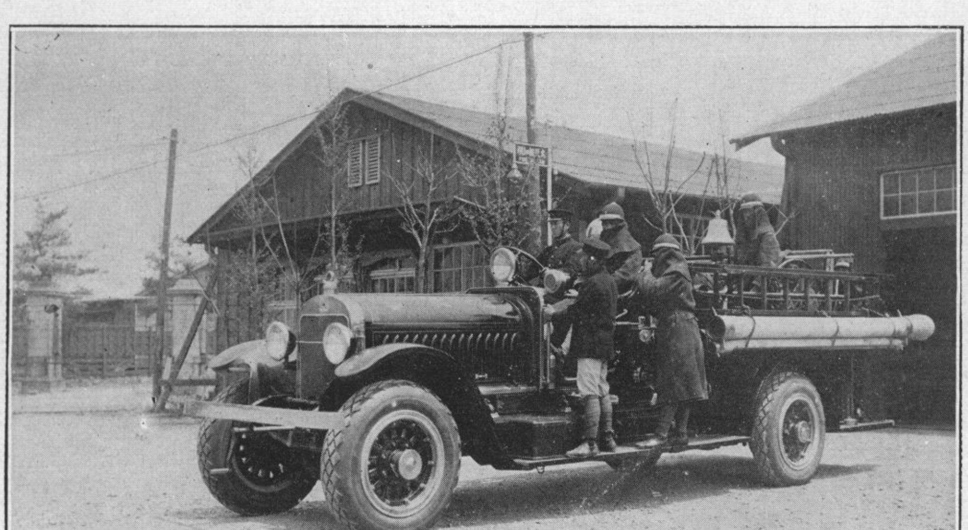
The history of the city shows that it is visited by a conflagration which reduces the greater part of the buildings to ashes at least once in every thirty years. The statistics for the last three years bring out the fact that there is an average of 984 fires a year, with an annual loss of Y.12,000,000 in property, which is Y.12,000 for each fire, the average loss being low on account of a large number of small fires which involve small dwellings and shops only. This is proof of the efficiency of the present fire-fighting equipment.

The first fire brigade was formed in Tokyo 275 years ago for the protection of buildings within the compound of the Yedo castle. This organization being still in existence to-day, is the oldest fire department in the world. A fire department for the protection of the city in general was organized in 1715 by the famous magistrate Ooka Echizen no Kami, which is followed to the present day in the auxiliary units of the city's fire brigades.

The organization of these old fire brigades was highly developed and their equipment as efficient as in any other part of the world at the same period. They corresponded in many ways to the volunteer fire brigades of the late seventies in the United States, but were supplemented by a professional organization of regularly paid men supported by the local communities and the city government. The same keen rivalry developed between the brigades of the various city wards as in America, where this rivalry almost overshadowed the real purpose of fire protection.

The city was divided into fire districts, each maintaining a station for the storage of equipment and a watch tower. The streets were patrolled by privately paid fire watchmen, while a lookout was constantly on duty at the top of the towers. The alarm was given by striking a bell in one of the towers, the number of strokes indicating the proximity of the fire in order that the citizens might be warned of both dangerously near fires and others which might spread to their district.

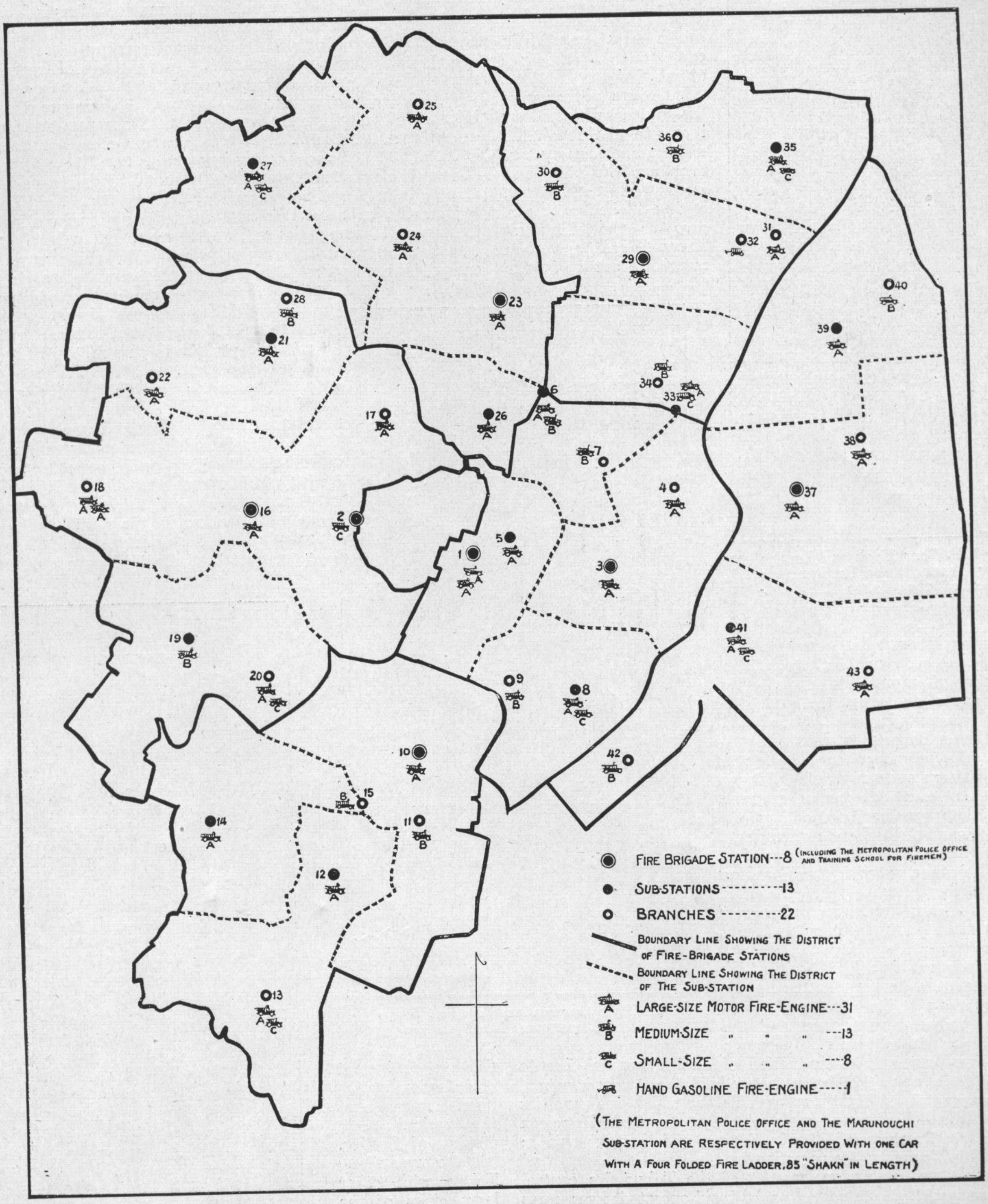
The volunteer brigades immediately assembled at their respective stations with their elaborate costumes, which were absolutely essential, and their individual equipment. Buckets were rushed to the scene of the fire and lines formed to the nearest moat as the only means of directly combating the flames. Small hand plunger pumps, one might almost call them squirt guns, were also used, but their effectiveness can be imagined. These old brigades were also trained in the tearing down of houses as a means of stopping the spread of the flames.



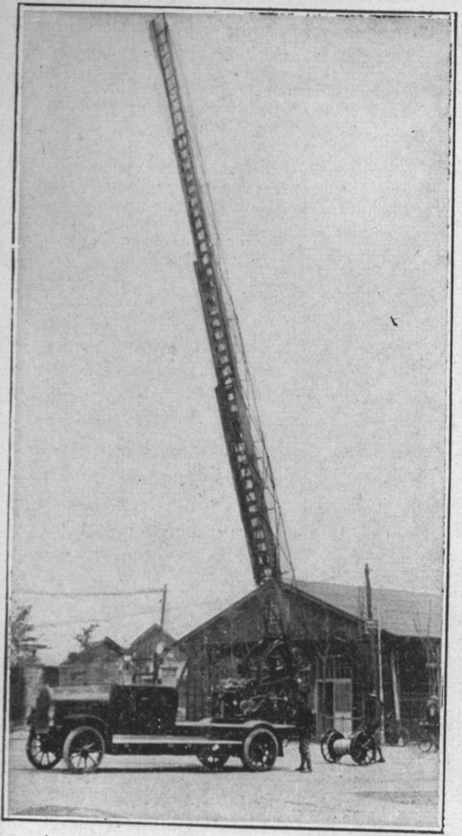
Stutz 140 H.P. Motor Fire Engine on duty at the Headquarters Station of the Tokyo Fire Department

The fighting of fire in the old days was also surrounded by an elaborate etiquette. Each brigade carried sacred and demon dispelling emblems which were planted on the roofs adjacent to the fire to prevent its spread. The standard of the company was placed as close to the fire as possible, and it was considered a great disgrace to have to move it back. This standard also served

Map Showing the Arrangement of Regular Fire Brigades in the City of Tokio



(1) *The Metropolitan Police Office* } Headquarters of Fire-Brigade
(2) *The Training School for Fire-men*
(3) *The First Fire Brigade Station*
(4) Hisamatsucho Branch of the above Station
(5) Marunouchi Sub-station
(6) Manseibashi Sub-station
(7) Odenma-Shiocho Branch of the above Sub-station
(8) Tsukiji Sub-station
(9) Sanjikkenbori Branch of the above Sub-station.
(10) *The Second Fire-Brigade Station*
(11) Shogenbashi Branch of the above Station
(12) Mita Sub-station
(13) Nihonenoki Branch of the above Sub-station.
(14) Azabu Sub-station
(15) Iigura Branch of the above Sub-station
(16) *The Third Fire-Brigade Station*
(17) Kudanzaka Branch of the above Station
(18) Shinjuku Branch of the above Station
(19) Aoyama Sub-station.
(20) Shinmachi Branch of the above Sub-station
(21) Nishigome Sub-station
(22) Wakamatsucho Branch of the above Sub-station
(23) *The Fourth Fire Brigade Station*
(24) Sojimachi Branch of the above Station
(25) Komagome Branch of the above Station
(26) Surugadai Sub-station
(27) Otsuka Sub-station
(28) Suidocho Branch of the above Sub-station
(29) *The Fifth Fire Brigade Station*
(30) Yanaka Branch of the above Station
(31) Umamichi Branch of the above Station
(32) Asakusa-Koen Branch of the above Station
(33) Asakusabashi Sub-station
(34) Mukoyanagiwara Branch of the above Sub-station
(35) Nihonzutsumi Sub-station
(36) Shitava-Kanasugi Branch of the above Sub-station
(37) *The Sixth Fire Brigade Station*
(38) Hanamachi Branch of the above Station
(39) Honjo Sub-station
(40) Oshiage Branch of the above Substation
(41) Eitaibashi Sub-station
(42) Tsukijima Branch of the above Sub-station
(43) Susaki Branch of the above Sub-station.

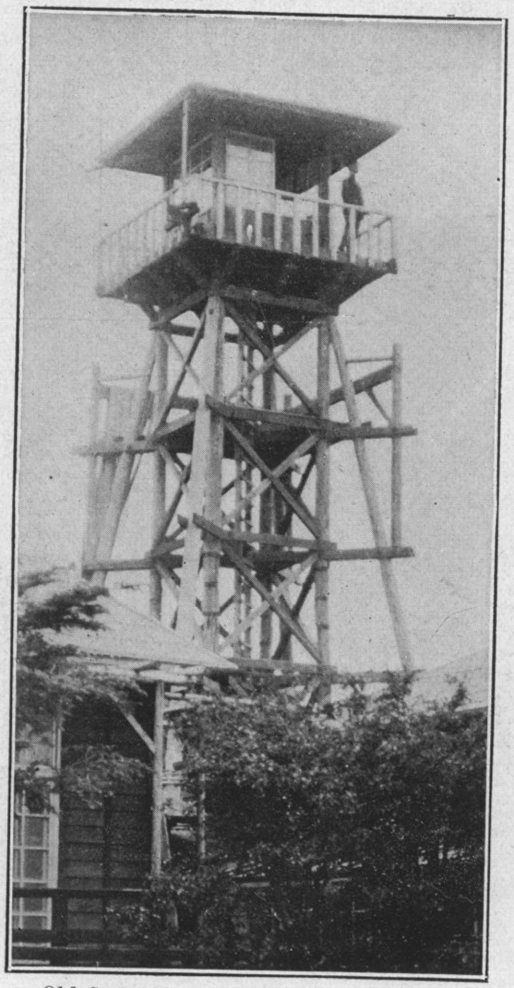


A 50 H.P. Benz Hook and Ladder Motor Truck at the Headquarters Station of the Tokyo Fire Department

to indicate the first arrivals at the fire, and the companies in attendance, in order that each might be rewarded in case of a successful attack.

Groups of men were designated whose duty it was to go through the district immediately surrounding The fire, and knock on each door, saying, "The fire is near, give us the children." The children were then marched out of the danger zone in an orderly manner and taken carc of, each child having an identification tag around his neck. The children out of the way, the saving of property followed, in which special divisions of the fire department assisted.

The old volunteer organization is still in existence to-day, the fireman wearing the same elaborate costume, carrying the same bamboo ladders, the same implements, with hand drawn pump carts as the only modern innovation. They still hold a great festival at New Year time, in which feats of acrobatics, supposed to be useful in swarming over buildings and saving the inmates, are a major feature.



Old Style Observation Tower at Tokyo Fire Department Headquarters

As was natural in a locality in which fire was so great a danger, the fire-bug or incendiary was punished with great severity, usually death by torture and the disgrace of his entire family. Inasmuch as most fires before the introduction of electricity were due to individual carlessness, the Japanese law held the family in whose home a fire started as directly responsible, for which due penalties were exacted. It is interesting to note that the Code Napolean also recognizes this responsibility in Europe, and that the opinion is still held in Japan at the present time.

The next period of development of the Tokyo fire control system came with the introduction of hand-operated hose carts and chemical extinguishers, which the Japanese adopted as soon as they learned of their existence. Since that time Tokyo has kept abreast of the latest equipment designed for fire protection. Horse-drawn steam pumps were used in the latter part of the Meiji Era (1892-1911), together with a more extensive waterworks system. The complete motorization of the department has since gone on rapidly, and Tokyo now has one of the model fire departments of the world.

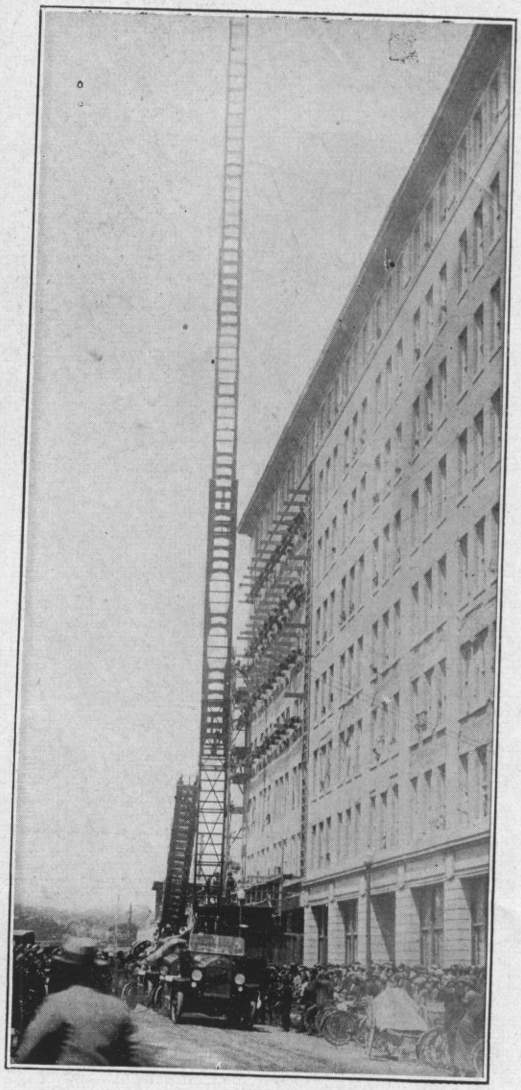
For the purpose of fire protection the city of Tokyo is divided into nineteen districts, with one fire brigade and one or more subsidiary posts attached to each district. In addition there are two brigade stations controlled by the Metropolitan Police Board with superintendence over a great number of smaller stations and volunteer posts. The total number of all main stations is forty-three; two police controlled stations, nineteen division stations and twenty-two detached posts. The total number of men regularly attached to these stations is 831, or an average of from 10 to 24 men at each place on duty alternately every other day.

Assisting the regular fire department there are the reserve brigades of voluntary firemen, each with one post and two hand-drawn hose carts each. The total number of men in this reserve is 1,520, 38 persons forming one company. The reserve assists the regular organization during the period of greatest fire danger, namely from November 11 to May 10 from 8 p.m. until 6 a.m.

In the suburban districts immediately surrounding Tokyo there are 188 companies and 52,000 men. They have a total of one hundred motor-driven pumps and 938 hand-pumps. These companies are supported by their respective villages and are under the direct control of the local police station. The rural brigades are almost entirely volunteer fire departments, but are well drilled and in a position to give material help to the city department.

The mechanical fire-fighting equipment of the city of Tokyo includes fifty-three motorcar engines, fifteen motor hose cars, three hook and ladder motorcars, one gasoline-driven pump and four other motorcars for officials and the division chiefs. It is planned to have at least two motorcar engines at each station in the future instead of at only ten stations as at present. There is also a geat deal of chemical apparatus and fire-fighting equipment of other kinds scattered throughout the various main stations of the city.

Comparing Tokyo with other large cities of the world shows that she is far behind in the amount of mechanical appartatus provided and in the number of men in the standing force. In New York there are eighty-five stations with 182 motorcar



The big Benz Ladder thrown up alongside the Marunouchi Building, Tokyo's tallest office building.

engines and 5,908 men; in London sixty-seven stations with 169 motorcar engines and 2,066 men; while Berlin has seventy-two stations, ninety-four motorcars and 1,101 men. It must also be taken into account that these cities contain a great number of fireproof buildings in comparision with the inflammable nature of most of the structures in Tokyo.

There is a total of 6,030 fire hydrants in the city, which is one hydrant for every seventy houses, and about ten to each mile of street. These are supplemented by 1,768 private hydrants suitable for fire fighting hose attachment. The pressure on the mains before the earthquake was forty pounds in the uptown districts and thirty pounds downtown, since which time the pressure has decreased slightly. Other sources of water supply for use in combating fires are twenty-nine reservoirs and 836 points beside the rivers and moats specially constructed for emergency pumping. On account of the tidal rise and fall of some of the rivers, these sources cannot always be relied upon, so that there are a number of private ponds in the compounds of the big mansions which are subject to the use of the fire department.

To improve the existing water facilities for fire protection the city authorities are now working on a high pressure system, the general idea of which is to supply water to Koishikawa, Hongo, Shitaya and Akasaka from the river Arakawa; Kojimachi, Kanda, and Nihonbashi from the river Edogawa of Sekiguchi and to Yotsuya, Ushigome, Akasaka, Azabu, Shiba and Kyobashi from the old watercourse of the Yodobashi, also to Honjo, Fukagawa and Tsukishima from the river Nakagawa. This plan includes the making of open spaces for pumping from the river Sumida and other smaller streams, by providing swimming pools in the parks and pools or foundations in the compounds of shrines and temples and other places of easy access for apparatus. Fire fighting craft will also be built for use on the river for fighting fires in vessels and near the river banks.

The Chief of the Tokyo Fire Department recently pointed out in a public address the greater needs of the city in improving its fire-fighting efficiency. He said that the parks and other open spaces of the city are only 19 per cent. of the total area, so that congestion of the streets at the time of a fire is often great enough to impede the progress of the equipment in reaching the scene in good time. Of the total length of roads in the city, 155.5 miles are over thirty-six feet in width, while the length of streets under thirty-six feet is 539.4 miles. These narrow roads often prevent the modern motorcar apparatus from approaching close enough to a fire to be effective. The importance of this fact is brought home by the statistics on the property loss at different fires, which is Y.6,300 per fire in the city and Y.25,000 in the suburbs where the roads are narrow and the equipment inferior to that in the central districts.

Before the earthquake there were 187 electric fire alarms, mostly in Nihonbashi, Kanda, Asakusa and Kojimachi, 70,000 telephones and 29 watch towers. This number has since been reduced, but is rapidly being brought up to the standard. In addition there is a plan to install automatic fire alarms every 240 yards, which would mean a total of 5,150 such instruments, with receiving apparatus at each of the seventy-five main stations. The fire brigades are well trained in

New Fire Alarm System Installed in Various Government Buildings with Control Station at Headquarters. This Installation, made by the Tokyo Fire Alarm Company, is the first step towards equipping the City with a modern fire alarm system

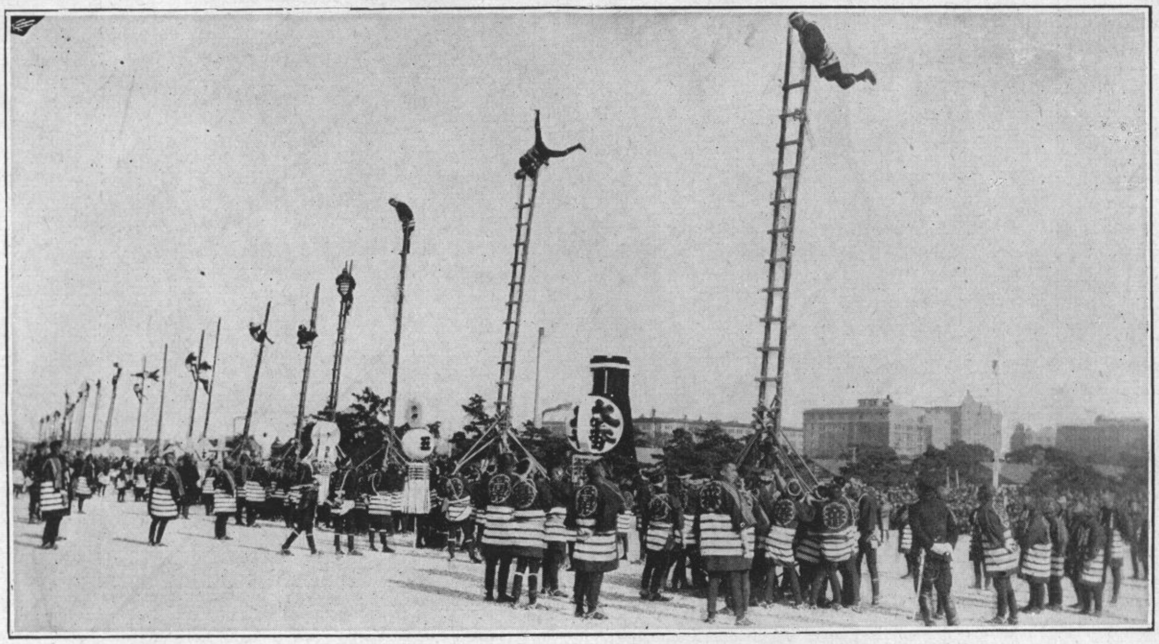
Tokyo's Fire Fighters at Work

reaching a fire quickly, the usual time being twenty seconds in getting away, and five minutes to reach the scene of the fire and lay hose lines. This good record is of no value, however, unless the alarm is turned in quickly, as was pointed out by the Fire Chief recently, and the installing of new equipment for giving the department notice of a fire will go forward as rapidly as possible.

The greater part of the city consists of only temporary structures built shortly after the earthquake and a number of barrack dwellings in all the congested residential districts, so that the risk of fire is much greater than at any other time. The streets are torn up in many places for repair and reconstruction work, still further hindering the work of the fire apparatus. These defects will be gradually overcome in the new zoning system which is to be rigidly followed in all permanent buildings, the widening of the streets in the general reconstruction plan, the building of parks, a greater number of fireproof structures and the improvements which are planned in the fire-fighting organization itself. The present system is worked out for the needs of the city at the present time and calls for the assemblage of at least ten motor fire engines at every barrack fire. The plans for the concentrating of apparatus are carefully worked out in accordance with the size of the fire, the force of the wind and the buildings involved, as to whether the second and third reinforcements are brought up.

Tokyo Volunteer Fire Brigade, showing Emblem of the East Company

The regular brigades are taught all the methods of fighting the complex fires of the present day by water and chemicals, smudging and by the destruction of buildings in the path of the flames. Daily drills are held in quick hose attachment, the use of the mechanical equipment, in the fighting of special fires such as in the taller buildings, theaters, hospitals and the like, as well as trial runs.



Tokyo has its Volunteer Fire Brigades, which meet in annual contests of skill. The above shows them doing some of their stunts. The ladders are held up by hooks

Educational fire prevention campaigns are being carried on by the police and educational authorities, which aim at the root of the evil and will materially reduce the number of fires caused by carelessness. The new building regulations are more strict in fire protection measures, with more attention paid to the methods of electric wiring, which have been the cause of a great number of fires in Tokyo. The improvement in all existing fire protection methods is therefore going on in a most thorough manner and should materially reduce the large losses by fire which have been the burning shame of the city for so many years. The time will soon come when "the flowers of Tokyo" will bloom in much less fertile soil and the clang of the alarm is heard at longer intervals.

The budget of 1924 set aside Y.947,694 for fire protection purposes under the control of the Metropolitan Police Board, and Y.344,412 to be expended in the outlying districts for the same use. The total loss by fire in the city of Tokyo during the same year amounted to Y.1,022,648, or a trifle more than the amount expended for protection. In the country districts immediately adjacent to the city the loss was Y.3,169,450, or ten times the amount set aside for fire fighting equipment. While these figures indicate that the losses are much less where more apparatus is provided, it must be taken into account that road conditions and water supplying the outlying districts contributed to the larger losses.

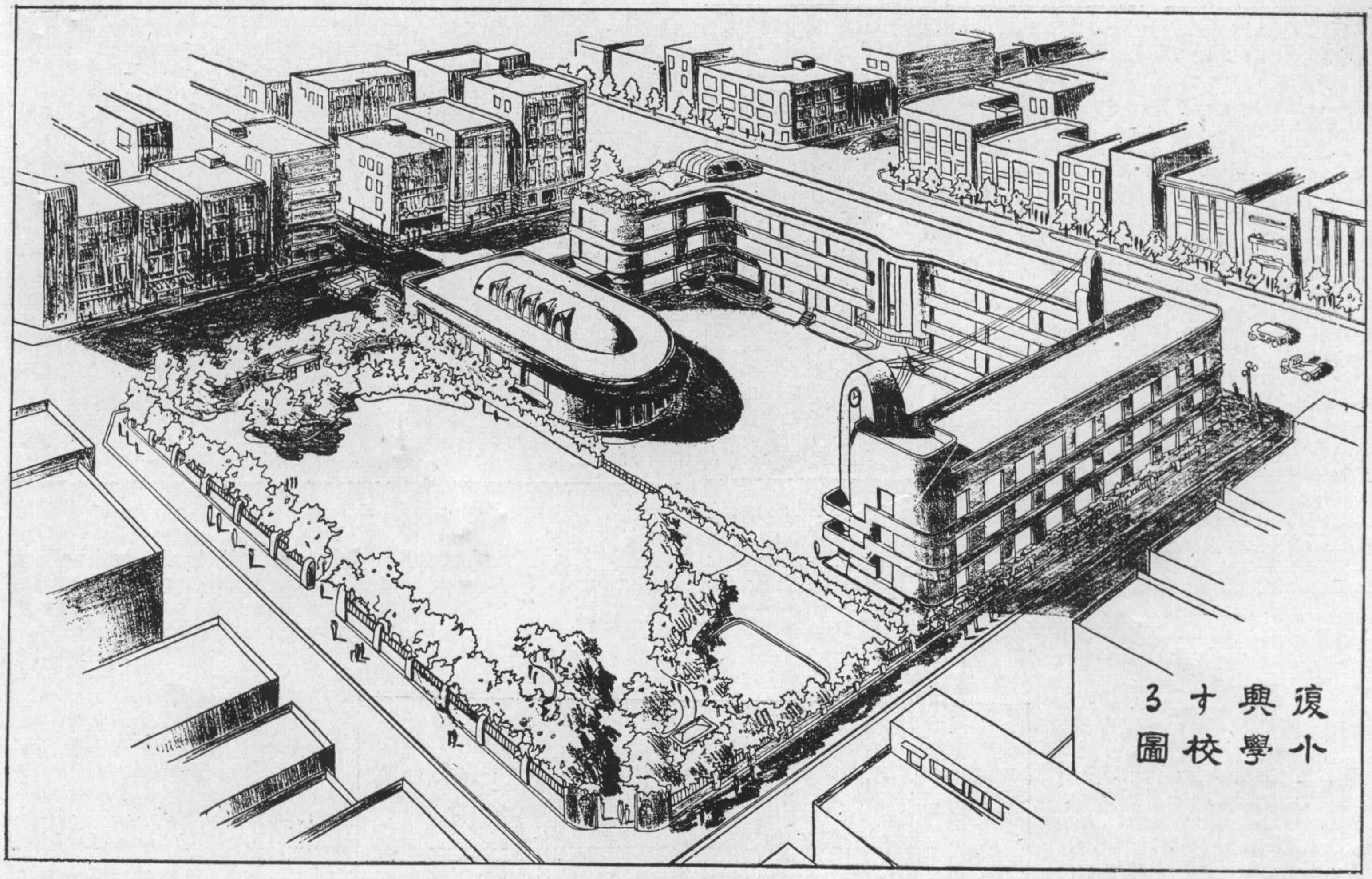
The total number of fires which broke out in the city and surrounding territory during 1924 was 946. It is interesting to note that of this total the largest number were caused by fires of unknown origin accounting for 196, followed by electricity with 93, 77 incendiary fires, 70 from defective chimneys, 67 due to carelessness with tobacco, 41 due to illuminating and heating gas, 40 from overturned hibachi (the charcoal brazier used for heating and cooking by the Japanese), with ash dumps and drying rooms next on the list. The balance of the figures originated in diverse sources such as candles, children playing with fire, oil lamps and the like. If the origin of the unknown fires were determined they would undoubtedly swell the total of incendiary fires and those due to electricity and careless disposal of lighted cigarettes.

A list of the more important pieces of motor fire-fighting equipment of the city is as follows:—

FIRE ENGINES

Chassis	Type of Pump	H.P.	Pressure in lbs.
Stutz	Northern Co.	140	250
American—La France	American—La France	120	„
„ „	„	105	„
Allen-Fox	Allen-Fox	85	300
Magras	Magras	75	120
American—La France	American—La France	75	120
Leland	Leland	48	120
Seagrave	Seagrave	77	120
Reo	Northern Co.	45	120
Hudson	Northern Co.	35	200
Dodge Bros.	Ishikawa	35	120
„ „	Teikoku	35	120
Benz	Benz	40	200
Benz	Benz	30	200

HOSE CARTS (3): Columbia, Dodge Brothers, Maxwell,
HOOK AND LADDERS CARS (2): Federal, Benz



117 New Primary Schools are to be Erected in Tokyo in the Next Three Years. They are all to be Three-storied Reinforced Concrete Structures, Equipped with Gymnasiums and situated as far as possible alongside small parks. The above is typical of the General Style, on Square Lots

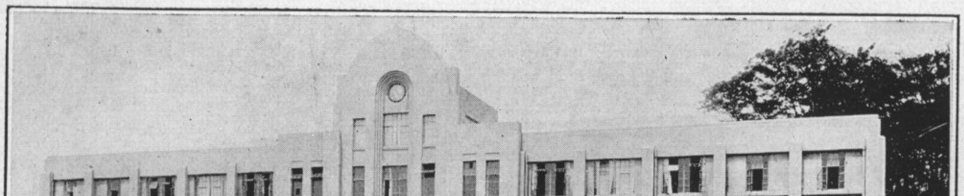
Schools for the People

117 Handsome New Primary Schools of Reinforced Concrete, with Park Playgrounds, will be Erected in Tokyo under the Reconstruction Program

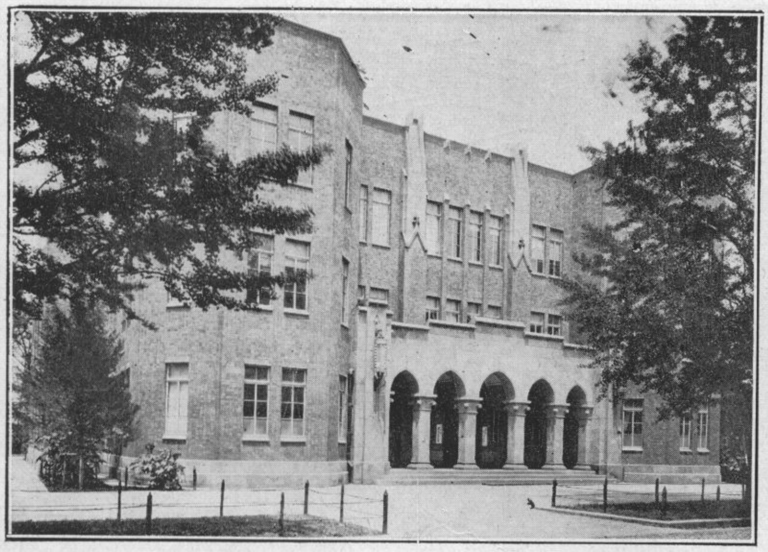
ONE of the largest items in the Reconstruction Budget is the appropriation of Y.54,810,000 for new school buildings in the devastated area. Of this sum, Y.38,-610,000 is allotted to Tokyo, Y.3,250,000 to Tokyo Prefecture, Y.10,950,000 to Yokohama City, and Y.2,-000,000 to Kanagawa Prefecture. Tokyo's allotment will be expended in rebuilding the 117 primary schools destroyed by the flames, of which 109 were district or ward schools, and eight under the direct supervision of the city. One new primary school, to occupy a site of 1,100 *tsubo*, is also provided for in the above appropriation.

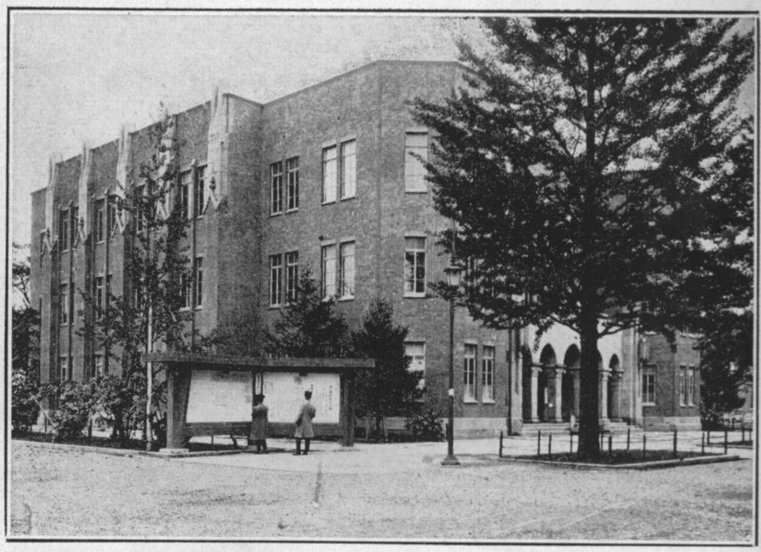
The National Government will bear one quarter of the costs of construction and equipment, and make advances to the municipality to meet the annual interest charges on the bonds to be issued for this purpose. Five modern fire-proof primary schools have been erected since the earthquake and plans for all the others completed. Pending a settlement of the new land adjustment scheme and the laying out of streets, construction work on the new schools has been held up. It is anticipated, however, that during the present year these obstacles will be cleared away, and construction will proceed rapidly in order to get the children out of the present unsightly and unsanitary barracks hurriedly erected after the disaster as temporary schools.

A standard type of primary school house has been adopted for the 117 buildings. Each building will be of reinforced concrete, three stories in height, with 24 class rooms, gymnasium and public hall. The detailed plans of each building will vary slightly according to the formation of the lot, which is to be of sufficient area



One of the Handsome Commodious New School Houses replacing the Old-type Building: The Kasei Middle School at Nippori, Tokyo, erected by Takenaka Komten





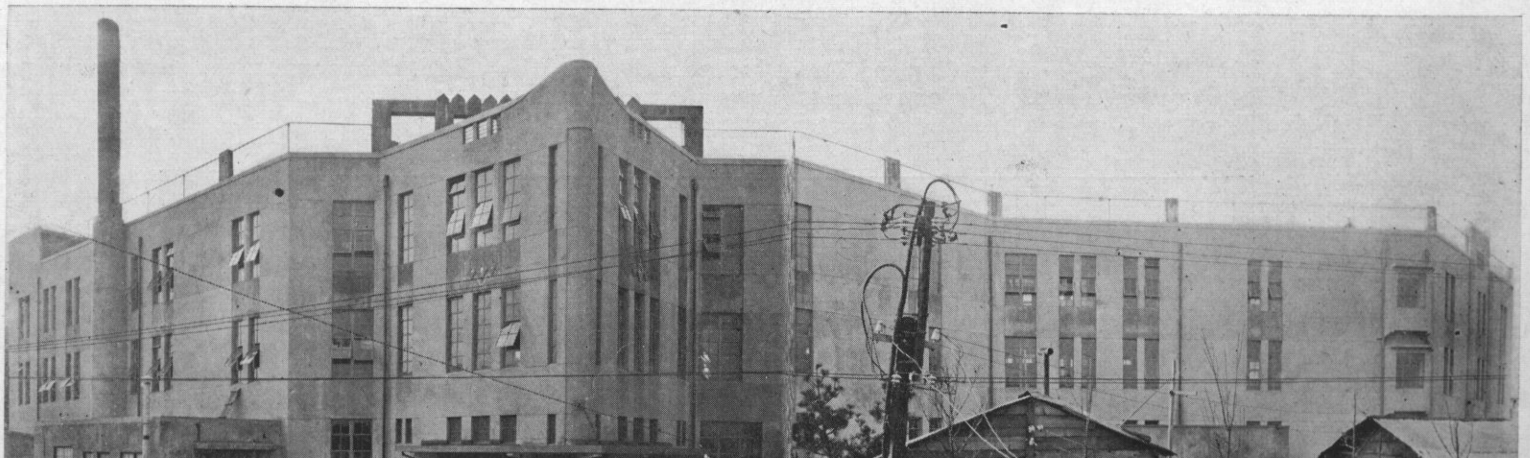
Imperial Univerersity Buildings at Hongo, Tokyo, erected by Tokenaka Komten

to permit of ample playground space. As far as possible, the sites for these schools will be located adjacent to the many small parks, of which 52 new ones are to be laid out by the city. The general lay out of these schools is shown in the plans on the opposite page. Each school is to be equipped with independent steam heating and ventilating plants and lighted by electricity. The grounds will be provided with various athletic facilities in addition to the well equipped gymnasiums in each building. Physical exercises form a large part of the training of Japanese school children. Each recess hour competent instructors put the youngsters through a setting-up drill, which is having a remarkable effect on the general physique and health of the new generation. The addition of a complete gymnasium equipment in every school house to supplement these exercises is an indication of the great interest shown by the authorities in developing the stature and physique of the children from the earliest age. These buildings, the last word in modern school construction, are an honor to the city and nation, the expression of a determination to maintain at all costs the high standards of education and hold the proud distinction which places Japan in the front rank of nations where illiteracy is almost unknown. It is regrettable that the appropriation for this work is spread over a period of five years instead of being immediately available.

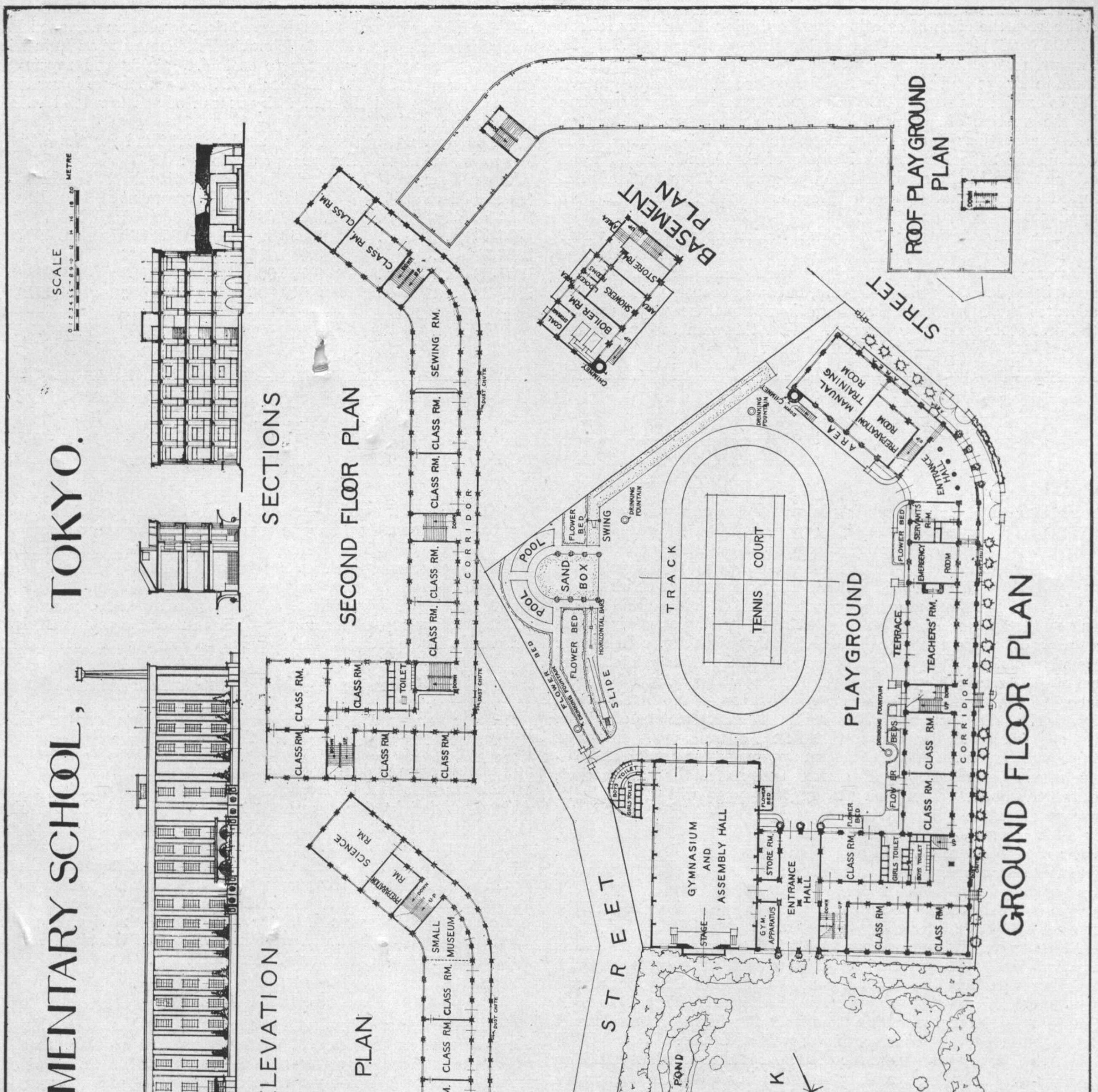
Tokyo Commercial School

Tokyo Prefecture will construct and equip five schools with its allotment of Y.3,250,000, the Third Middle School, the First Higher School for Girls, a School of Industrial Technology, School of Industrial Chemistry, and a School of Technology. The full amount will be loaned to the prefecture by the National Government at a suitable rate of interest. These must be completed before the end of 1927, and as soon as the replotting of the city permits, construction will be taken in hand and pushed to completion.

Yokohama's allotment from the national treasury will be one-fourth of the total expense of Y.10,950,000, in addition to which the National Government will advance the funds to the city to meet the annual interest charges on the bonds issued for this pur-



One of the Reinforced Concrete Primary Schools Erected after the Earthquake. When the temporary Wooden Shacks are Removed, the Site Cleared of Debris and the Grounds Laid Out and Ornamented, this Building on its Irrigular Lot, will Present a more Diguified Appearance


KINKWA ELEMENTARY SCHOOL, TOKYO.
ELEVATION
SECTIONS
SCALE
FIRST FLOOR PLAN
SECOND FLOOR PLAN
BASEMENT PLAN
ROOF PLAY GROUND PLAN
GROUND FLOOR PLAN
LIBRARY
MUSIC RM.
CLASS RM.
TOILET
CORRIDOR
SMALL MUSEUM
SCIENCE RM.
PREPARATION RM.
SEWING RM.
DUST CHUTE
BOILER RM.
SHOWERS
STORE RM.
COAL
CHIMNEY
GYMNASIUM AND ASSEMBLY HALL
STAGE
GYM. APPARATUS
STORE RM.
ENTRANCE HALL
GIRLS TOILET
BOYS TOILET
TEACHERS' RM.
EMERGENCY ROOM
SERVANTS' RM.
TERRACE
FLOWER BED
PLAYGROUND
TRACK
TENNIS COURT
DRINKING FOUNTAIN
SWING
SAND BOX
POOL
HORIZONTAL BARS
SLIDE
MANUAL TRAINING ROOM
PREPARATION ROOM
AREA
ENTRANCE HALL
STREET
PARK
POND
SWINGS
N

pose. The appropriation is made available over the period 1924-29, and covers the costs of erecting and equipping 31 primary schools (Y.10,230,000) and one Commercial College to cost Y.700,000. The primary schools are to be built to the same general plan as those in Tokyo and must be provided with 1,100 *tsubo* of ground, not to exceed a cost of Y.300 per *tsubo*. Sites have been acquired for the erection of four schools; plans are now completed for two, and preparations for construction are now being made. The Commercial School is to cover a site of 2,400 *tsubo*, and, like all other schools in the reconstruction program, will be built of reinforced concrete and equipped throughout with the most modern appliances.

The small towns in Kanagawa Prefecture suffered severely during the earthquake, and in the local fires at Kamakura and Odawara nearly all public buildings were damaged. The schools must be replaced by the prefecture, but the Reconstruction Budget allocates Y.2,000,000 as a loan from the national treasury on which the prefecture must pay interest. With this sum the prefecture will build and equip a Commercial and Industrial Training School, a Girls' Higher School, Girls' Normal School with an attached Primary School, the First Middle School in Yokohama and an Industrial School. The new schools are to cost Y.1,671,000 and repairs to old buildings Y.329,000. The costs of these schools are lower than those in Tokyo and Yokohama by reason of the low land values in the country districts.

The expenditure of the general school fund for the city of Tokyo is spread over five years as follows :

Fiscal Year (April 1-March 31)	Total	National Government	Municipality.
1924-25 ...	Y.8,000,000	Y.2,000,000	Y.6,000,000
1925-26	8,000,000	2,000,000	6,000,000
1926-27	8,000,000	2,000,000	6,000,000
1927-28	8,000,000	2,000,000	6,000,000
1928-29	6,610,000	1,651,500	4,957,500
Total	Y.38,610,000	Y.9,652,500	Y.28,957,500

The Municipal Central Market

ONE of the most important of the new public utilities to be built for the city of Tokyo is a great central wholesale market equipped with every modern convenience for the rapid receiving and dispatching of meat, fish, vegetables and produce of all kinds. This market will supersede the older Nihonbashi fish center and concentrate at one point the produce arriving from all parts of Japan, enabling the health authorities to exercise a more effective control over the food products before being exposed for sale in the retail shops. The site for the new market is to be somewhere along the Tokyo waterfront, preferably on the block owned by the Navy Department in Kyobashi. If this cannot be obtained, the site will be located on reclaimed land at Shibaura. Although the final plans have not as yet been approved, the municipal architects have perfected several different designs for the new market, of which the one shown on the opposite page will probably be accepted. The estimated cost of the site, covering 84,298 *tsubo*, is about Yen 6,547,500. The buildings will cost Yen 4,299,400, their equipment another Yen 3,561,143, while the cost of plans, supervision and inspection calls for another Yen 501,957, a total cost of Yen 15,000,000.

A special railway siding will connect every building in the market with the main railway at the Shiodome freight station, while on the waterfront side a large floating landing stage will enable trawlers and fishing boats to discharge their cargoes rapidly. Another wharf, equipped with special cargo handling machinery, will be constructed to accommodate fishing and other vessels of 2,000 to 3,000 tons, which, in turn, calls for dredging the channel to the outer bay and constructing protective banks.

A belt-conveyor system for the rapid and convenient handling of light-weight packages will be installed in all the buildings, fifty electric trucks will be used to transport heavier pieces within the market limits, and a special delivery service of 50 motor trucks will facilitate the assembly and distribution of produce throughout the city. There will also be two grain elevators and an independent water supply from six artesian wells. All of the buildings are to be of reinforced concrete equipped with ventilating, heating and refrigerating systems. The buildings, designed for the storage and handling of various products, will have storage and sales rooms under the same roof, the largest of the buildings being used for the storage and sale of fish, the principal food of the Japanese. The fish market will have 800 *tsubo* of floor space and an additional 5,800 *tsubo* for stalls. The vegetable building will have 200 *tsubo* of storage space and 2,500 *tsubo* for sales stalls. There will also be fruit, meat and egg storage and marketing buildings, 800 *tsubo* of packing rooms, and four auction rooms. Cold storage for fresh, dried and salted fish, meat and eggs will be provided by the installation of a plant of 2,000 tons refrigerating capacity per day in addition to a 30-ton ice machine. Special underground rooms for the ripening of fruits will be a feature of the market installation.

Offices for the market authorities, a bank and post office, stores for the sale of miscellaneous merchandise, inspection rooms, a fire station, police box, toilets, garbage and waste disposal bins, stables and other structures are included in the general scheme. All walls, floors, drying spaces, water drainage, moat, toilets, waiting rooms and buildings are to be of reinforced concrete, the whole conforming to the most advanced ideas for the handling of perishable food products for the population of a great metropolis.

Kanda and Koto Branch Markets

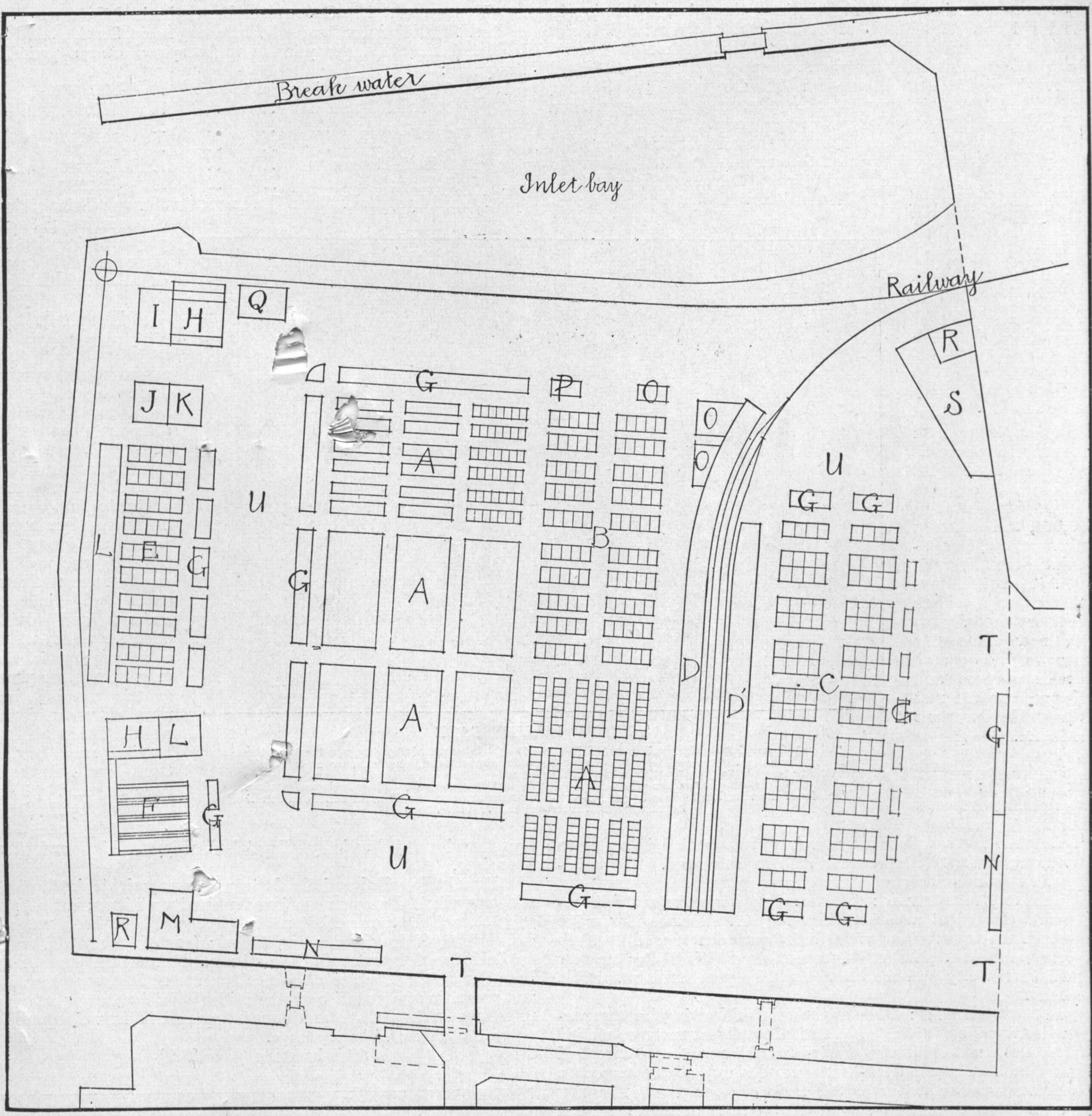
The main central market is ultimately to have two branches which will absorb all the existing privately operated markets scattered throughout the city whose excessive charges, it is claimed, add about fifty per cent. to the prices of foodstuffs. One of these branch markets will be located at Kanda, in the vicinity of the Akiwabara freight depôt, and the other at Koto, in Honjo, near the Ryogoku Freight Station. Most of the fruit, vegetables and garden produce from the country districts is received at these stations, and the new markets will be specially designed and constructed to receive these products direct from the railway cars on one side and deliver them for distribution throughout the city the other side by means of motor trucks or the navigable canals. Another Yen 7,500,000, exclusive of the cost of the sites, will be required for the construction of these branches.

Yokohama Market

The Reconstruction Budget also provides Yen 4,000,000 for the construction of a central wholesale market at Yokohama, of which the National Government will furnish one-fourth. The site for this market has not yet been decided upon, and construction may be delayed for another year or so. However, the general construction and equipment will correspond with that of the Tokyo Central Market, but on a smaller scale.

Garbage Disposal Plants

Supplementing its improved water and sewage systems, the public health of the city of Tokyo will be further safeguarded by the installation of an up-to-date garbage disposal system. The sum of Yen 1,850,000 has been appropriated in the Reconstruction Budget for the purpose of erecting 27 garbage collecting stations in various districts of the city, located for the most part on the banks of navigable streams and moats to permit of cheap and inoffensive transportation in barges to three main disposal plants. There are at present 18 garbage collecting stations scattered throughout Tokyo working under the old system. These are to be enlarged and their equipment modernized. The plans call for nine new reinforced concrete collecting stations two stories high, equipped with electric elevators, revolving bins, wagons, trucks, etc.



Ground Plan of the Proposed Central Market for Tokyo to be Erected on the Water Front at a Cost of Yen 15,000,000: A, Fish Stand; B., Wholesale Fish Stalls; C, Fruits and Vegetables; D. Platform for Fish; D, Platform for Vegetables; E, Dried and Salted Fish; F, Meat, Poultry and Eggs; G, Waiting Room; H, Refrigerating Room; I, Engine Room; J, Ice Plant; K, Ice House; L. Store; M, Bank, Post Office, Office, Dining Room; N, Shops; O, Wholesaler's Office; P, Dining Room; Q, Packing and Forwarding Room; R, Garbage House; S, Cattle; T, Gate; U, Car Field.

The three disposal plants, designed to handle about 1,666,000 lbs. of garbage per day, will be equipped with drying apparatus, and hydraulic presses calculated to reduce the gargabe 80 per cent. in volume and 40 per cent. in weight. Two of these plants will cover an area of 212 *tsubo*, while the other will be of double capacity and size. Their cost is estimated as follows: Sites, Yen 360,000; buildings, Yen 672,000; equipment, Yen 753,180; and construction supervision, plans, inspection, etc., Yen 63,920. The National Government will stand one-fourth of the total appropriation for this purpose, spread over a period of three years 1925-27. Detailed plans for the buildings and equipment have not been drawn, but the above general sketch will give a fair idea of their lay-out.

Social Welfare Work

Several years ago the Municipal authorities of Tokyo created a Bureau of Social Service for the purpose of providing comforts and necessary facilities that would alleviate the condition of the working and poorer classes. Under the direction of this Bureau, six employment agencies, two day nurseries, five restaurants, three bath houses and one lodging house were erected and thrown open to the public. The employment agencies gave their services free and were the means of obtaining work for thousands of men and women every month. The "official restaurants," so called, supplied wholesome meals at fixed hours at a maximum charge of 15 sen, but no drinks. The food was better than in many public

restaurants charging four and five times the price, but owing to the restriction on the sale of intoxicants, the service was not particularly popular with the classes it was desired to benefit. On the other hand, office clerks and the poorer students acclaimed the new innovation with great joy. The free public bath houses, located in the poorest districts of the city, were also a great boon to a people who set cleanliness above godliness.

The work of the Bureau became so popular and successful that the authorities appropriated the sum of Yen 4,525,000 in the reconstruction program for the erection of 62 new buildings to house its expanded activities. The National Government agreed to provide Yen 450,000, or half the estimated costs, to erect fifteen two-storied reinforced concrete buildings to be used for the public employment agencies. The land required for this purpose is 825 *tsubo*, of which the city now owns 390.

DAY NURSERIES: The program also calls for ten two-storied reinforced concrete buildings to cost Yen 500,000, to be used as day nurseries, accommodating 100 children each. These buildings will average 140 *tsubo* of floor space. The city now owns 634 *tsubo* to be devoted to this purpose and will purchase the rest as suitable locations are found.

WORK ROOMS FOR WOMEN: Five two-storied reinforced concrete buildings covering 160 *tsubo* of floor space each will be erected in order to provide piece-work for women not steadily employed. The buildings are designed to accommodate 300 women each.

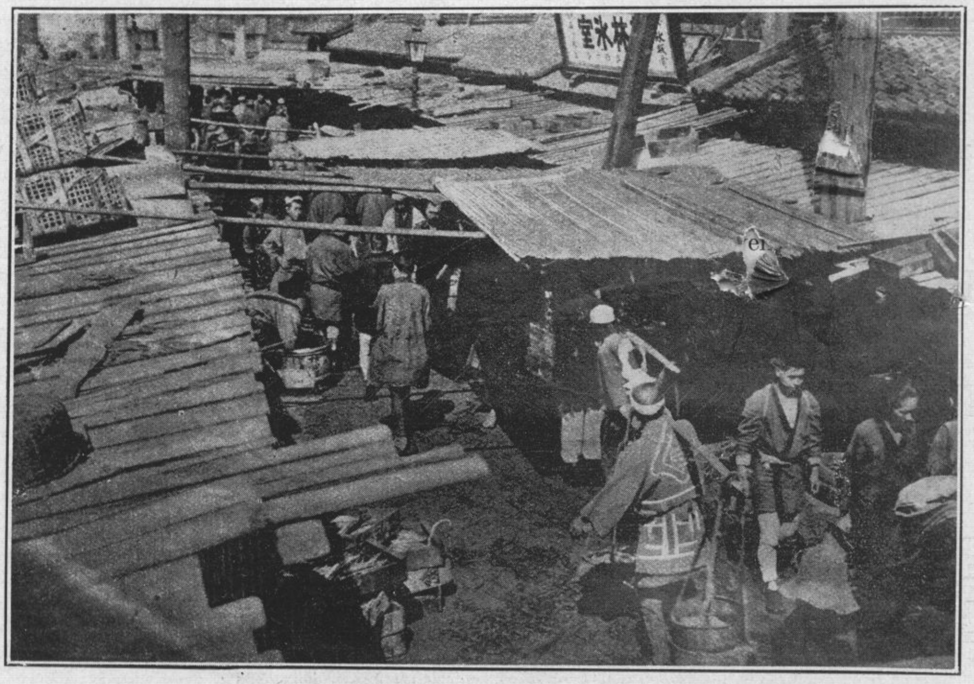
PUBLIC RESTAURANTS: There are to be ten new public restaurants erected at a cost of Yen 500,000. There will also be two-storied reinforced concrete buildings averaging 100 *tsubo* of floor space each. Nearly 700 *tsubo* of the required sites are now owned by the city and the balance will be purchased in suitable localities.

LODGING HOUSES: One of the original lodging houses partially destroyed by the fire will be rebuilt and ten new two-storied reinforced concrete buildings erected for this purpose at a cost of Yen 500,000. These lodging-houses are designed to accommodate 200 persons and will average 360 *tsubo* of floor area. The city possesses 340 *tsubo* required for the sites of these buildings and will purchase the balance (1,800 *tsubo*).

PAWN SHOPS: Seven two-storied reinforced concrete municipal pawn-shops, averaging 38 *tsubo* of floor space each, are to be effected at a cost of Yen 175,000.

BATH HOUSES: Ten two-storied reinforced concrete public bath-houses, with dressing-rooms and laundry, to accommodate 1,000 persons each, are to be built at a cost of Yen 600,000. Each building will require 100 *tsubo* of ground, which is to be purchased by the city.

The appropriation for carrying out this program became available in 1924 and will extend over a period of five years. One work building for women has been started and the plans for all the others completed. The delay in pushing forward the work is due to the difficulty in acquiring suitable sites owing to the long-drawn-out negotiations surrounding the adjustment of the boundaries of the districts. As soon as these essential land questions are settled immediate work will be commenced on all the buildings embraced in the Social Service program.



TOKYO'S BILLINGSGATE

Tokyo's General Fish Market is situated in the Nihonbashi ward of the city, not far from the Stock Exchange. The catches of highly valued Pacific salmon, the popular New Year's gift, are brought to the adjacent Salt Fish Warehouses—a row of red brick godowns—whence they are distributed over the city and the South and despatched to Manchuria and China. The local distribution is largely carried out by canal-boats on the 63 main canals and their branches which intersect the various wards

YOKOHAMA: The Government has authorized the expenditure of Yen 750,000 to construct the following Social Service buildings in Yokohama, the appropriation to be spread over a period of five years:

3 Employment Agencies to cost ..	Y. 90,000
10 Small Markets	100,000
2 Restaurants	100,000
2	60,000
3 Bath Houses	180,000
3 Work Houses	120,000

As in Tokyo, the National Government will pay half the costs of constructing the employment agencies and one-quarter of the cost of the other buildings.

Hospitals

Few hospitals escaped the devouring conflagration which raged for three days after the great quake, and with them went the dispensaries, physicians' and surgeons' consulting and operating rooms, their instruments, appliances and the drug and medical supply stores. Thousands of injured, maimed and dying cried for relief, which came rushing in not only from other parts of the empire, but from all parts of the world. The immediate hospital needs of the Capital and Yokohama were supplied within two weeks by the American army and Red Cross equipment hurriedly dispatched from Manila and San Francisco.

Practically all hospitals destroyed were private institutions with very limited accommodations for charity patients; in fact, the entire hospital accommodation of Tokyo of 15,000 beds was reduced to 6,000 by the disaster, and of this number only 3,700 were available for ordinary or charity patients. To meet this emergency, barracks were hastily erected by the Government to serve as hospitals and consulting dispensaries where certified physicians were permitted to receive their patients and perform operations in well-equipped operating rooms, without charge.

(Continued on page 312.)

Wholesale Fruit Stall in Market

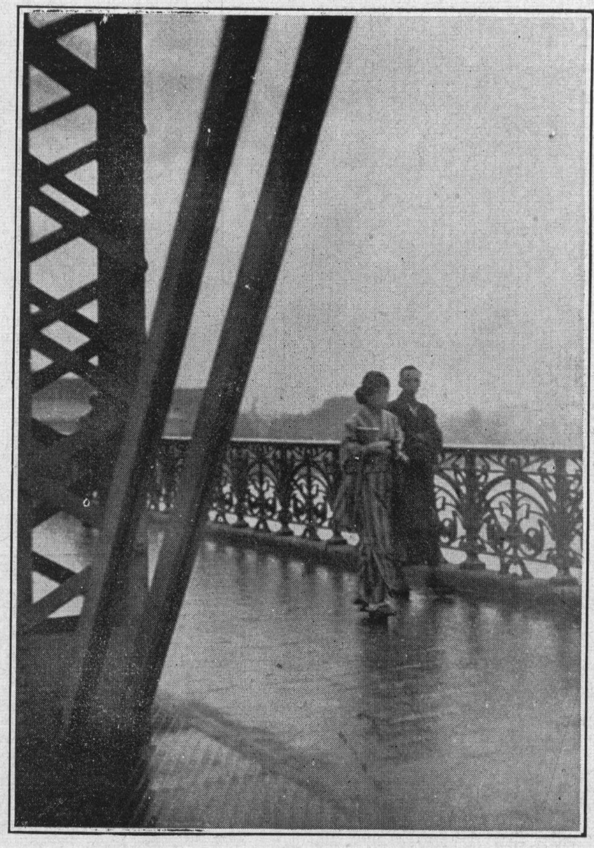
The Sumida River Bridges

Six Handsome New Steel Spans Will Connect the Main Part of Tokyo with Honjo and Fukagawa Wards.

Foundation Company's Exports Direct Caisson Work.

SOON after the great disaster of September 1923 the Japanese Government formed what is known as the "Bureau of Reconstruction" for Tokyo, Yokohama and adjacent districts within the devastated area. The fact that Tokyo, like Venice, is a city of waterways made these common carriers and the hundreds of bridges spanning them one of the chief problems of reconstruction. At the present time practically all of the old bridges are either being rebuilt or have been made temporarily safe for traffic. In addition, several new bridges have been planned and are being built to connect up old arteries of travel heretofore dead-ended at the banks of a river or canal.

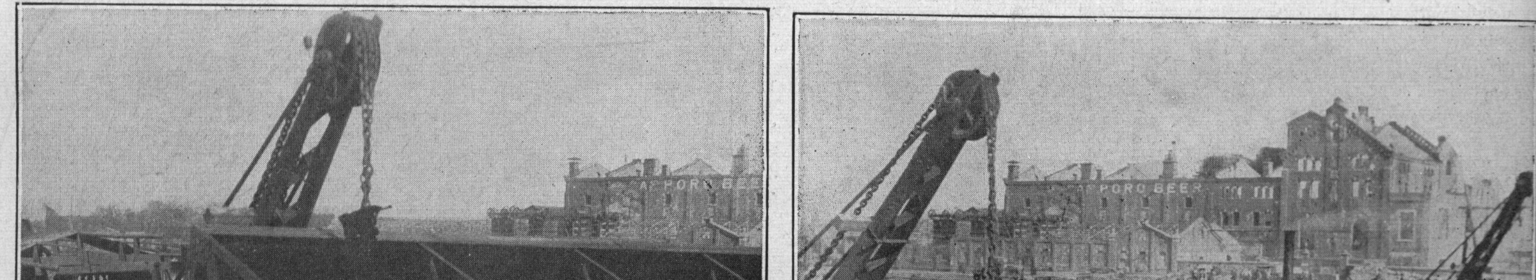
The principal and largest waterway is the Sumida river, which flows through the heart of Tokyo and divides the city into two districts, much the same as New York is separated from Brooklyn by the East river. The Sumida, which is a tidal stream, varies in width from 100 to 600 or 700 ft. and is a comparatively deep waterway throughout its course in Tokyo. Several bridges span the Sumida, and due to geographic conditions already mentioned are of the heavier type, as they carry the main trolley systems and other heavy traffic which naturally converges to them. Several of these bridges were made unsafe for travel by the earthquake, and it was here that the Reconstruction Bureau first turned its attention. Temporary wooden trestles were built adjacent to the damaged structures to carry the trolley cars and heavy vehicular loads, and the old steel structure was reinforced and made safe for the lighter traffic.



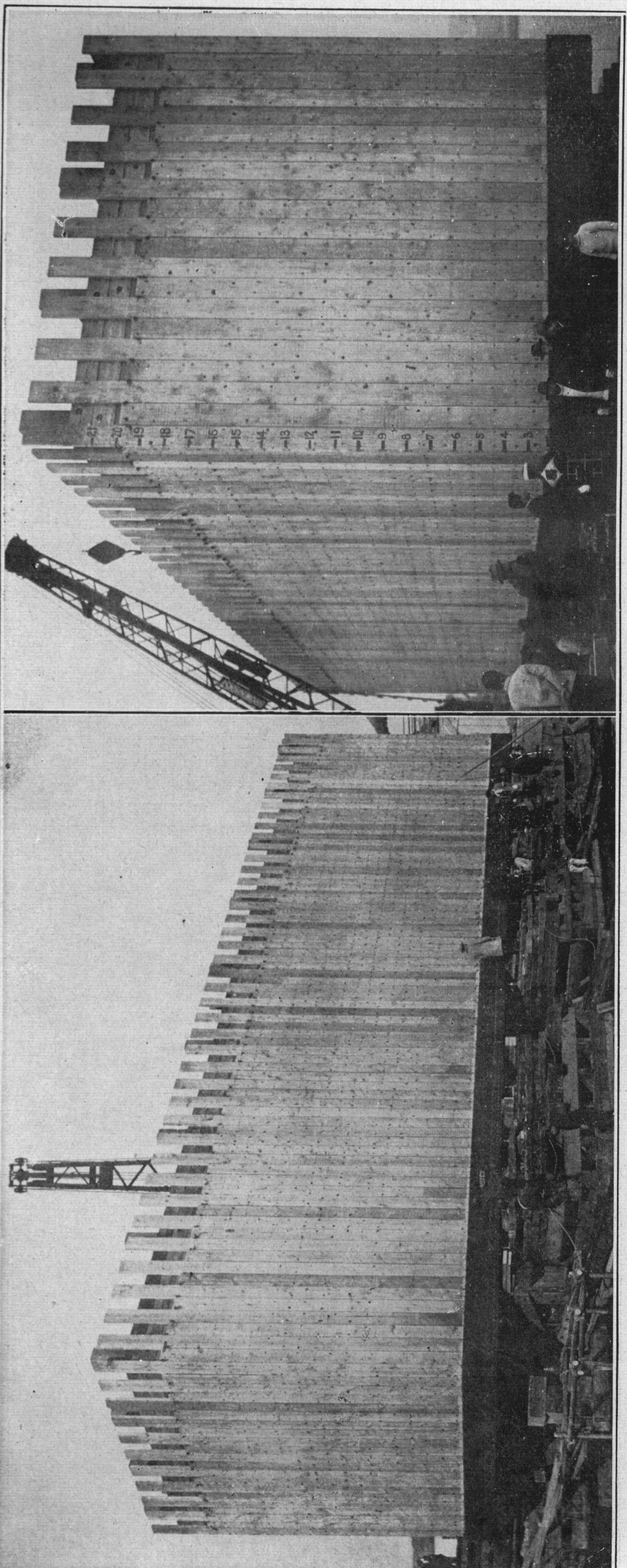
A Sumida River Bridge

Due to poor sub-surface conditions and the absence of rock or other good materials for sustaining heavy bridge piers, it was decided that deep pneumatic caisson foundations offered a solution for the future Sumida river bridges. Inasmuch as pneumatic work has never been attempted in Japan, and the special machinery and devices necessary for employing compressed air was not available, it was decided to employ The Foundation Co. of New York City, specialists in this type of construction, to direct the work. At the present time Eitai Bashi and Kiyosu Bashi, two of the largest of the many bridges near the mouth of the river, are well under way and will be ready to receive the steel superstructure early in 1926.

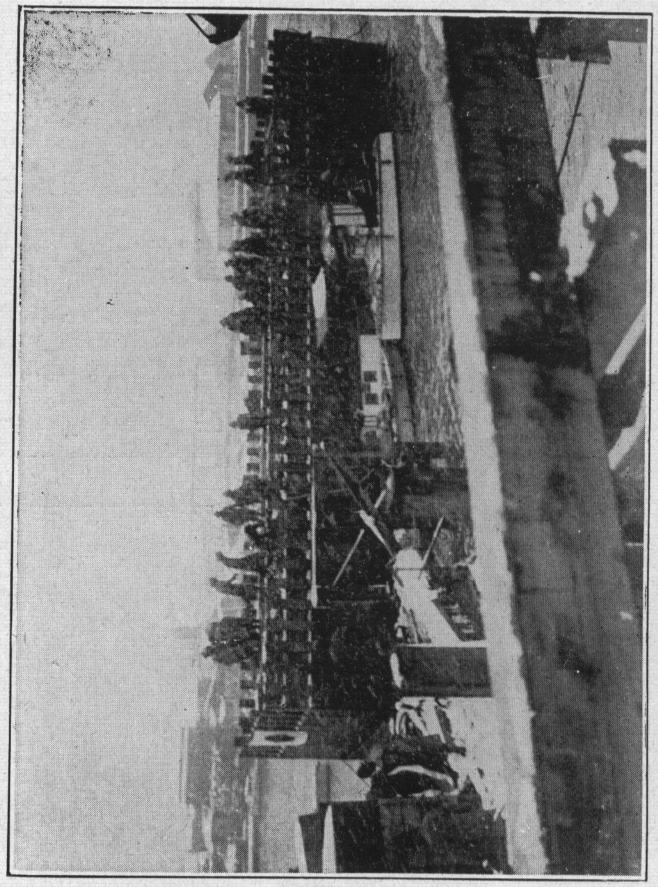
There are several different methods and ways of sinking river caissons, and the one employed depends of course upon the conditions at and adjacent to the proposed site of operations. Some of the main factors to be considered are :—Depth of water ; whether river is a tidal or swift moving stream ; character and amount of traffic ; nature of river bottom and soil conditions and availability of space for building the caisson itself. This description will therefore be confined to the method employed in building and sinking the caissons in question, namely those for the Sumida river bridges.

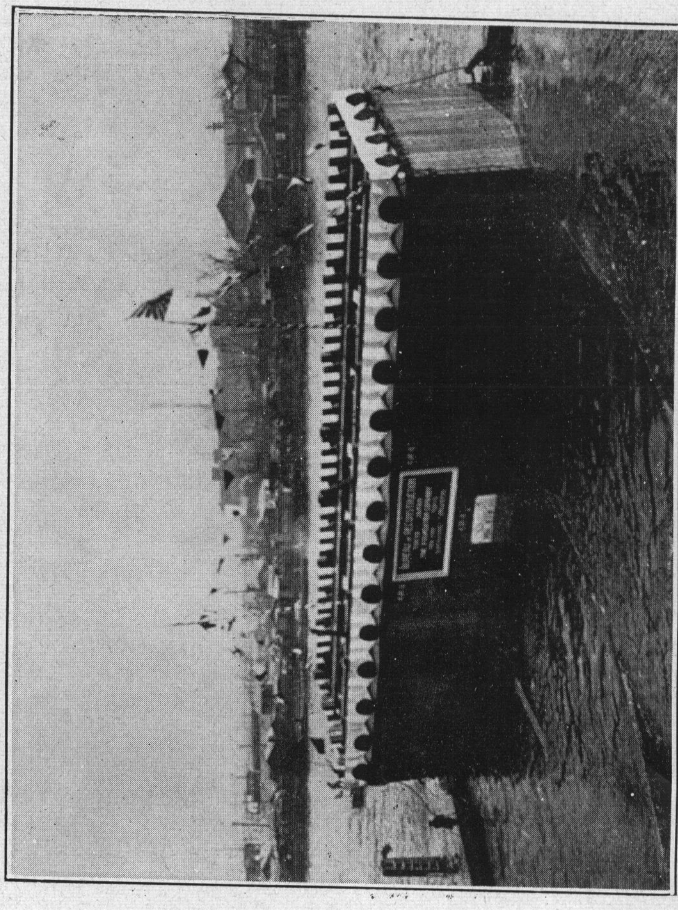


Repairing the Azuma Bridge over the Sumida River

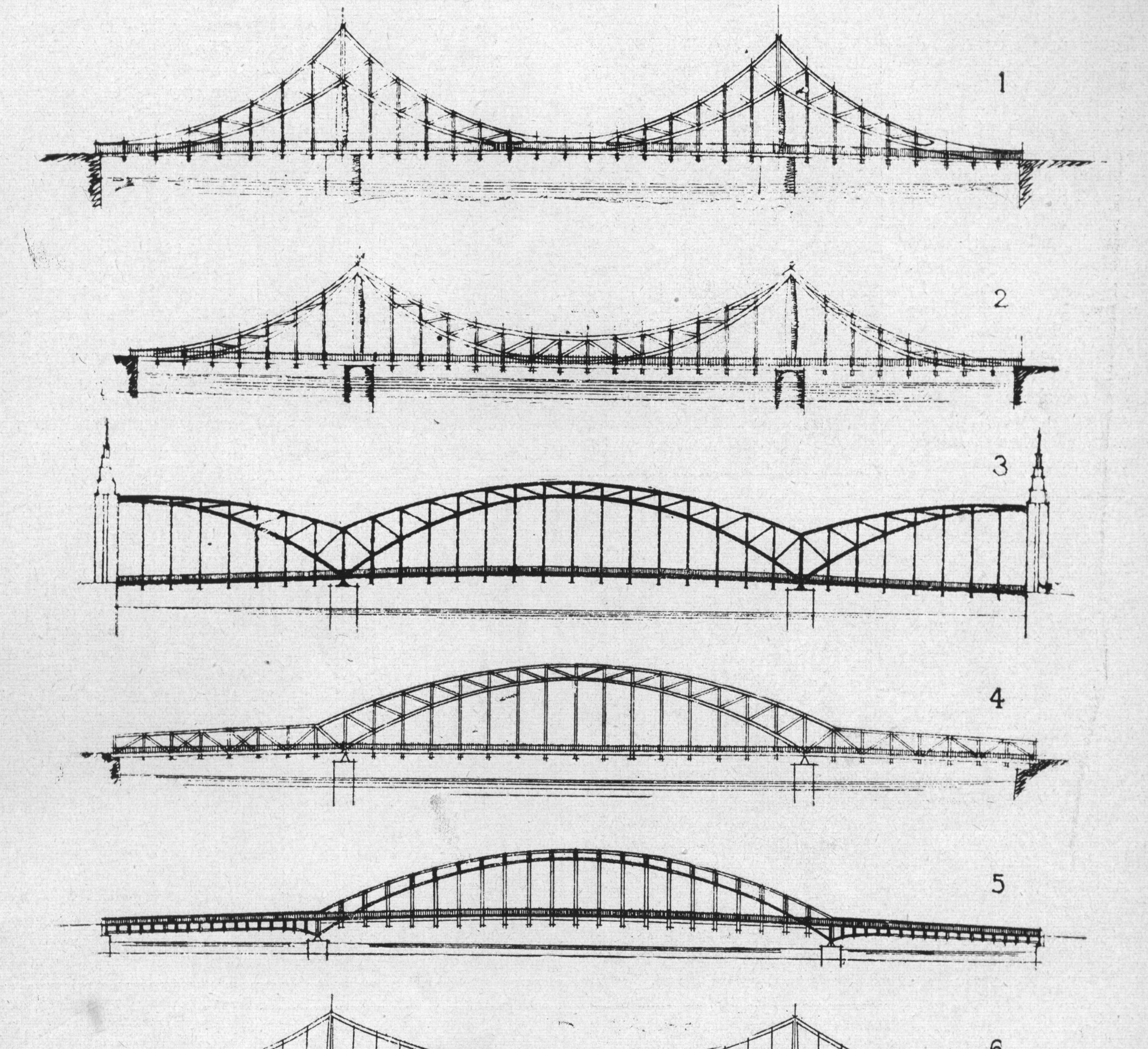


Caissons for the Eitai Bridge over the Sumida River, built at the Kuramae Yard of the Reconstruction Bureau, Ready for Launching



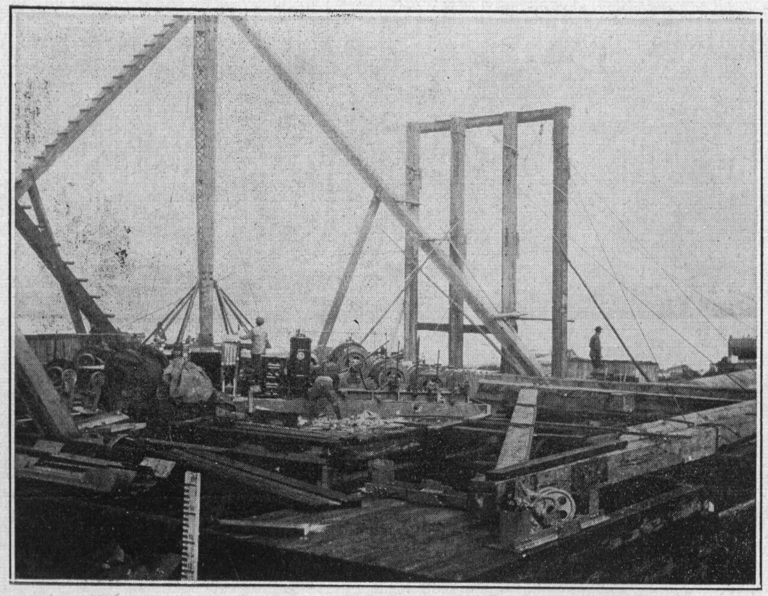


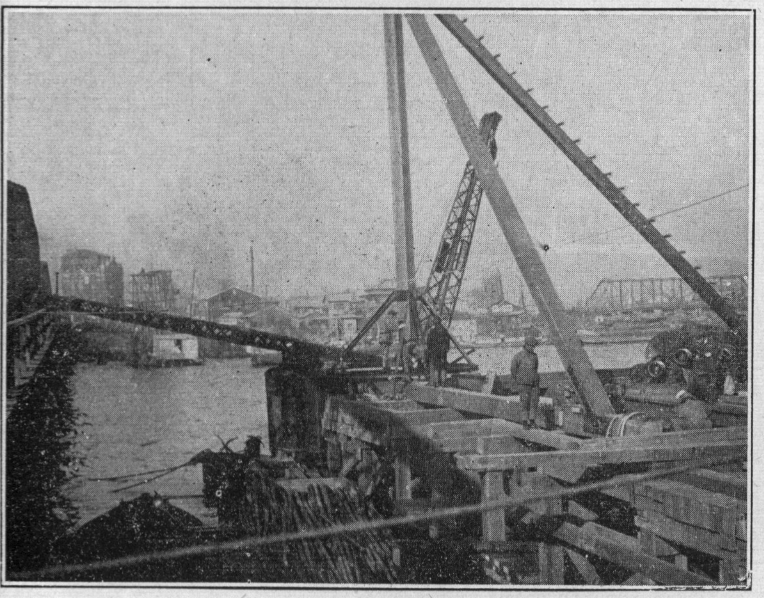
Caisson After Launching

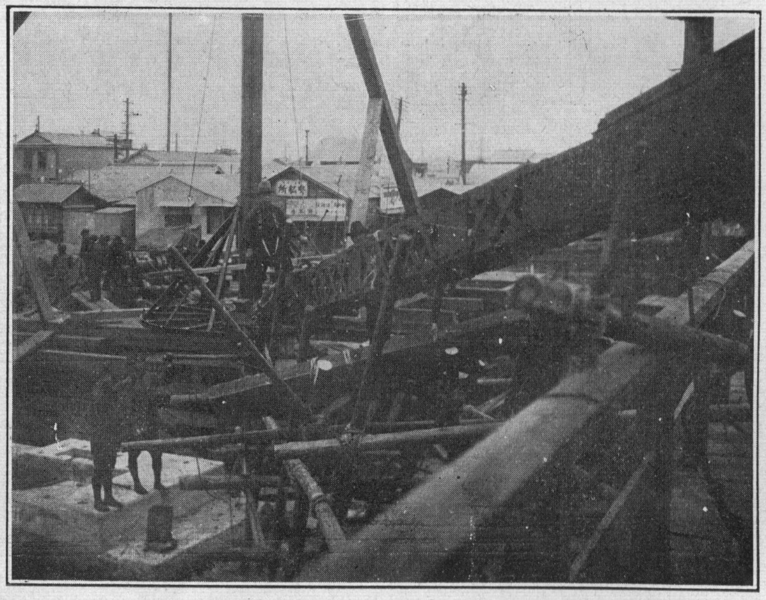


Types of New Bridges over the Sumida River:—5, Eitai-Bashi; 6, Kiyosu-Bashi; 7, Komagato-Bashi; 8, Koromae-Bashi; 9, Aioi-Bashi.
The Steel Work for these New Bridges is being Fabricated at the Japanese Government Steel Works at Yawata

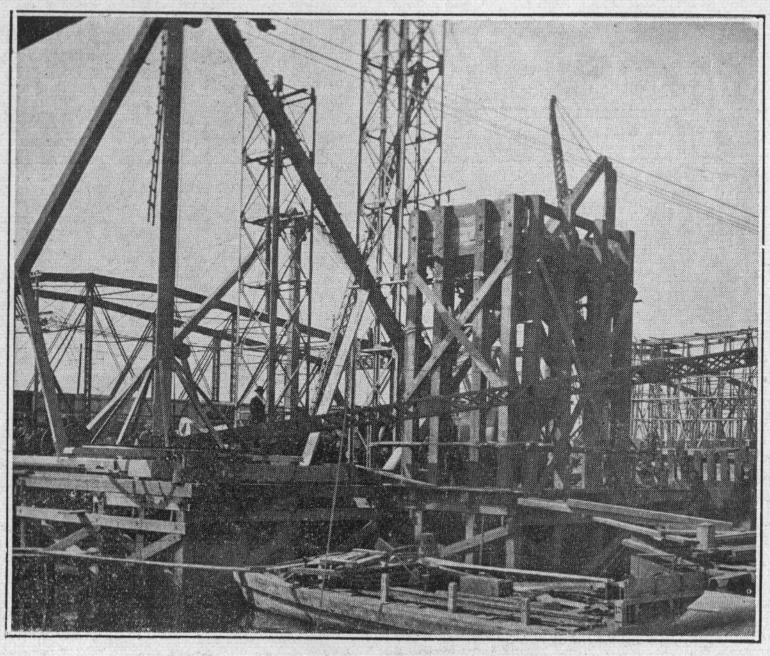
The Reconstruction Board's yard at Kuramae, which is about three miles north of Eitai, was chosen as the best available site for building and launching the caissons. Here again special care had to be taken not to get the caisson too heavy or build it too high on account of the depth of the river and the fact that it had to be towed underneath two bridges before reaching Eitai. Launching ways, similar to those employed in launching ships or scows broadside, were built on a pile foundation, the piles having caps running parallel to the shore line, and on top of these were placed four parallel timber runners spaced evenly over a distance of 70-ft. Timber cradles, each 22-ft. long, were placed on the runners and built in such a way as to make four level points of support for the steel-cutting edge superimposed upon them. The cutting edge, which is 20-ft. wide and 80-ft. long, forms a foundation on which to erect the "working chamber," or what is more commonly known as the first build-up of the caisson.







In the case of Eitai Bashi, the first build-up was 24-ft. high and 20-ft. by 80-ft. in plan. It was built much the same as the first storey of a heavy frame building except that the studs or upright posts were thoroughly bolted to the steel cutting edge. Bolted to the outside of the posts, and in horizontal layers, were 8-in. by 10-in. timbers for a height of 20-ft. This framework was rigidly cross braced and covered with vertical 3-in. by 12-in. sheeting. The length of the sheeting was alternately 18-ft. and 22-ft. in order to form a saw tooth effect at the top and provide for a staggered joint when the next build-up was added. Inside, and at the bottom, the working chamber, which is the place or room where the excavation is carried on, was built. The chamber is 6-ft. 6-in. in height, and the side slopes inward from the steel cutting edge, making it about 10-ft. by 7-ft. at the roof, or deck as it is more often called. Two 48-in. diameter holes were then cut through the deck at the one-third points and a length of steel shaft firmly bolted over each. The next move was to caulk the entire build-up, remove the temporary blocking and clear the site for launching. The entire structure weighed about 200 tons and was launched at high tide by cutting the mooring ropes holding the four cradles simultaneously.



Sinking the Caissons for the Eitai Bridge

While the above was in progress, clusters of guide piles had been driven at Eitai, to which were fastened vertical hard-wood rubbing blocks. The build-up was then towed to the site and placed in position between the rubbing blocks, with a clearance of about six inches on either side. Another 18-ft. lift of timber was then added and caulked as before. At the same time concrete was being placed inside to sink the caisson to river bottom. This process of building up, concreting and extending the steel shafts was continued until the caisson was 42-ft. high and the cutting edge firmly embedded in the mud or river bottom.

The air locks were next bolted to the top of the shafts and the air lines run from the compressor plant to the caisson. At this time the cutting edge was about 16-ft. below mean water, and it was therefore, according to the laws of physics, necessary to apply about seven pounds of air to lower the water to that point. By applying a greater pressure, however, the water was driven out of the working chamber in a very few minutes, and the pressure was then lowered to the balancing pressure mentioned above. A gang of twenty men

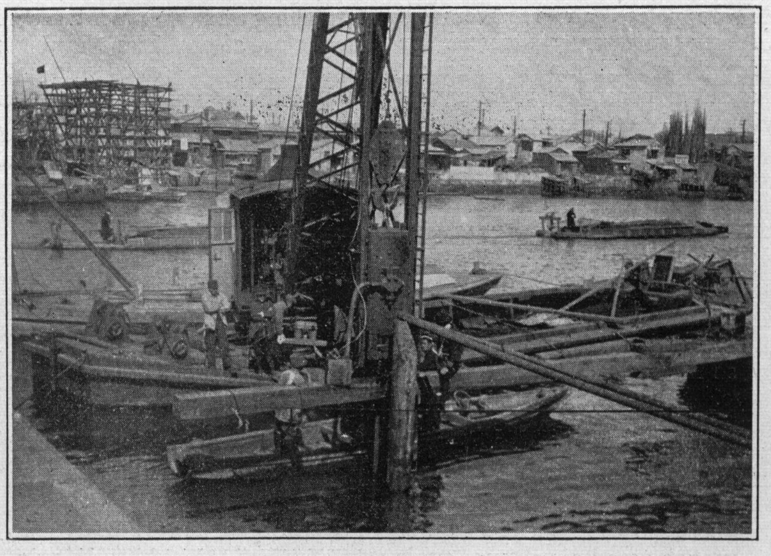
were then sent into the working chamber and the process of excavating or undermining the caisson started. Excavation is carried on night and day, and as the caisson settles or sinks additional build-ups and concrete are added, until the cutting edge reaches rock or soil of sufficient sustaining power to support the bridge pier and its corresponding loads. The working chamber is next filled with concrete, under air pressure, and the whole pier is complete, ready to receive the masonry shaft on which the bridge seats rest.

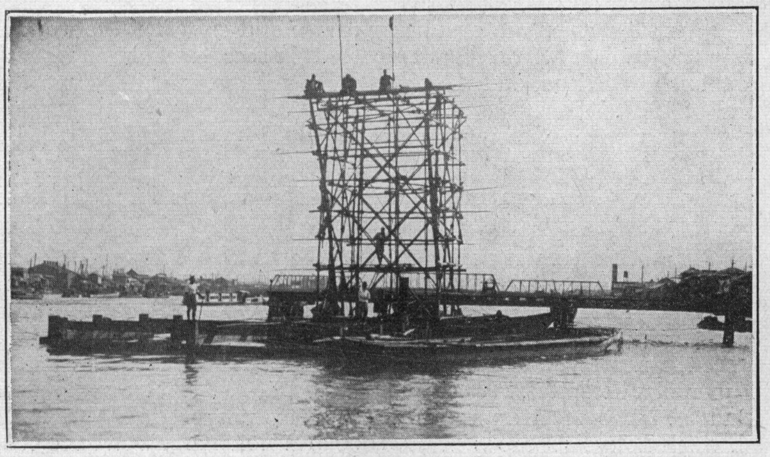
The two bridges, now under construction by the above process, each have four piers, two river piers and two abutment piers. The abutment piers are sunk in exactly the same manner, except that the water is very shallow and they are built in place on a temporary earth fill.

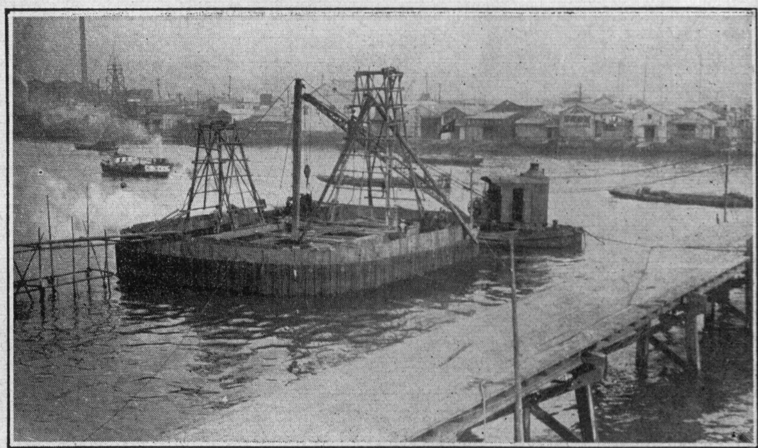
The air plant, which is described below, is mounted on scows and thus easily and quickly moved from the site of one pier to the next.

Unlike the ordinary or general construction operation, caisson work calls for specially designed machinery and equipment, and great care must be taken at the time of installation to make its operation as nearly fool-proof as possible. With few exceptions, once air work is started the caisson must be sunk as a continuous operation; this, of course, calls for an intercepted flow of air and a compressor plant equipped to meet the emergencies of large or small volumes at different ranges of pressure.

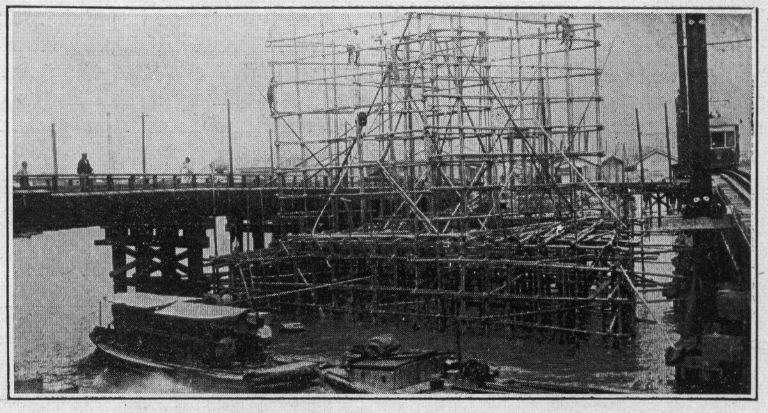
In general the air pressure applied to a caisson comes under the head of "low air," that is the pressure ranges from five to fifty pounds; and hence the machines are designed to supply large volumes at a comparatively low pressure. The air leaves the compressors at about 100 degrees Fahrenheit and passes directly to coolers of the circulating water type. It is customary to carry from ten to twenty pounds more pressure than the work demands; hence the decompression which takes place when the air enters the working chamber has an additional cooling effect. Between the coolers and the

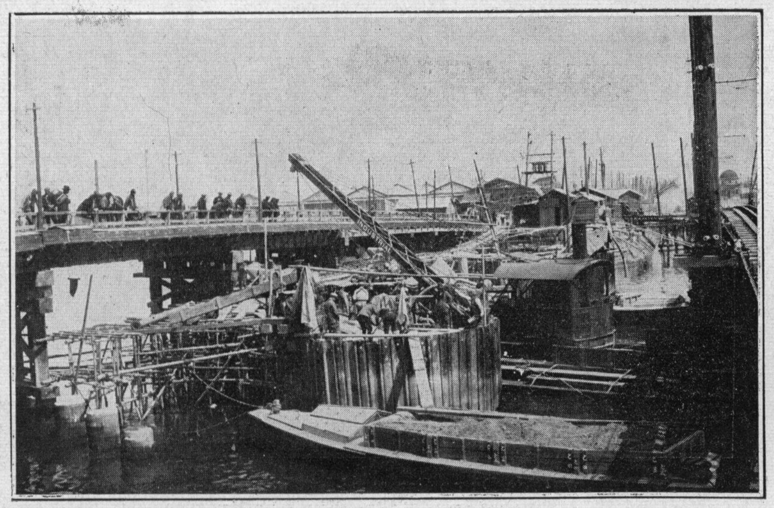


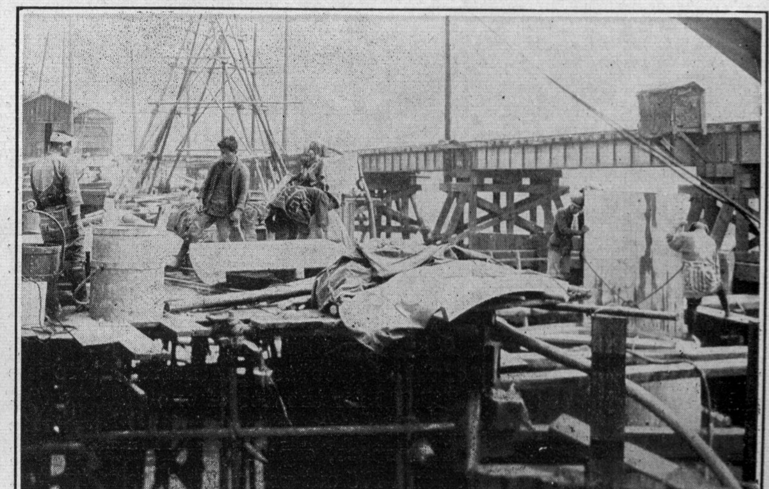




Pier Foundations for the Komagata Bridge over the Sumida River. "Lakawanna" Steel Piling is Used to Form the Caisson







Preparing the Pier Foundations for the Aio Bridge over the Sumida River. "Lackawanna" Steel Piling Used in Caisson Work

line leading to the caisson itself are placed air receivers of sufficient capacity to take care of any emergency demand for air while the compressors are being speeded up or another auxiliary unit cut in. The volume of air necessary to carry on any given caisson operation depends entirely on the nature of the soil encountered while sinking, and for this reason the capacity of the air plant is usually made large enough to fulfil the requirements of the worst conditions possible. Failure to observe the last mentioned fact has often been the cause of serious loss of property, not to mention occasional loss of lize.

There are several types of air locks in use at the present time, and all of them have their special features and advantages when applied to different jobs. The lock used at Eitai is as near a combination of all the different patterns as is possible, and at the same time it is easy to operate and positive. It is sometimes called the "direct lock," in that the same bucket that is loaded in the working chamber is taken through the lock and dumped on the spoil boat. The lock is bolted to the top length of shaft leading to the working chamber and is nothing more or less than a duplex check valve on a large scale. There is a chamber between the upper and lower check valve flappers, or doors, large enough to admit a one cubic yard dirt bucket; and a four-inch by-pass or equalizing line controlled by valves on the outside, leading from this chamber to a point underneath the lower door. The doors are so arranged that the edge of the upper one is directly over the centre of the lower one; in order that a cable stuffing box may be placed in such a position as not to interfere with the operation of the upper door and still allow the bucket to fall freely through the lower door. Assuming that the lower door is closed and held so by the pressure of the air in the shaft leading to the working chamber below, the bucket is lowered into the lock chamber and, after fastening the cable in the stuffing box, the upper door is closed and the equalizing valve opened. When the pressure in the lock chamber is the same as that below the bottom or lower door, the latter is opened and the bucket lowered to the working chamber, where it is loaded and again hoisted to the lock chamber. The lower door is now closed and the air exhausted from the lock, thus allowing the top door to be opened and the bucket to be hoisted out and over to the spoil boat. The shafting, mentioned heretofore, consists of 10-foot, 48-inch diameter steel cylinders flanged together with bolts and tubular gasket. The shaft is provided with two steel ladders, the edges of which serve as a guide for the bucket and give ample clearance for a man to clear the bucket when ascending or descending the shaft.

Outside of the usual equipment, derricks and concrete plant, the only other special piece of apparatus is the hospital lock. This lock is a large steel cylinder 6-feet in diameter and 20-feet long, placed in a horizontal position and operated much the same as the Muck lock on the caisson proper. Its purpose is to treat patients afflicted with caisson disease, or commonly known as "bends." It is provided with heat, light and benches, where the men may rest while being treated by the always present nurse.

Schools for the People

(*Continued from page 306*).

The need for larger hospital services for the poor was so clearly demonstrated at the time of the disaster that one of the first items approved in the Reconstruction Budget were those providing for the early erection of a Municipal charity hospital to cost Y.600,000. This building is to be of two-storied reinforced concrete construction, covering about 1,100 *tsubo*, and equipped to accommodate 300 beds, with consulting rooms to attend to an equal number of out-patients. In addition to the hospital, the Reconstruction Budget includes the sum of Y.2,500,000 for the purchase of sites and the erection of four dispensaries for the city of Tokyo, each building to occupy not less than 1,500 *tsubo*. A plot of 2,318 *tsubo* was purchased before the end of 1924 at a cost of Y.345,000 for the site of one of these dispensaries, on which will be erected a two-storied reinforced concrete building with 900 *tsubo* of floor space, capable of accommodating 175 beds in the various wards and 175 out-patients. The estimated cost of the building is Y.270,375, with an additional Y.169,950 for furnishing and equipment. Consulting rooms will also be provided for the use of physicians having no offices of their own, equipped with all modern appliances and instruments for medical examination and ordinary surgical operations.

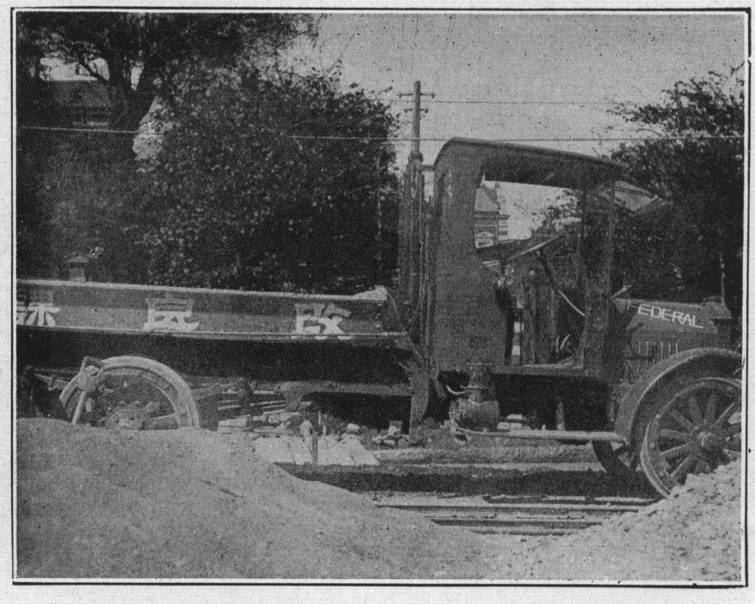
In addition to the program of the Reconstruction Bureau, the Tokyo Municipality will erect six new hospitals, located in Azabu, Okubo, Fukagawa, Kojimachi and Hongo, at a total cost of Y.5,380,000. The sixth will be built in Matsukura-cho, Honjo, for the exclusive treatment of laborers and persons living in the slum districts. This hospital will cost Y.2,520,000.

A feature of all these new hospitals will be the isolation ward, in which persons suffering from infectious or contagious diseases will be treated. At present it is necessary to send all such cases to the Komagome isolation hospital, the only one of its kind in the city, and the delays consequent to getting patients to Komagome has not only been the cause of a large number of deaths, but has also been a handicap in checking the spread of epidemics. Upon the completion of the new hospitals the patients will be taken to the one nearest, and it is hoped in this way to save a number of lives which otherwise would be taken by epidemics.

The first of the hospitals is to be constructed in Horoo, Azabu, the plans for which are now being drawn and on which the work is expected to be started in September. The second will be in Okubo, a suburb of Tokyo, and the other three will be finished before the end of 1926.

All the buildings will be of reinforced concrete, three stories high, with basements and gardens on the roofs. They will be equipped with modern instruments and apparatus and will have adequate staffs of doctors and nurses.

The sanitation situation of Yokohama was even worse than Tokyo, as only one hospital escaped the fire. However, the Juzen Byoin, a municipal institution, although severely damaged by the quake, escaped the flames. An appropriation for its repair, together with the necessary funds to construct a Contagious Diseases and a Tubercular Hospital, were provided for in the general Reconstruction Budget. The total appropriation for this purpose is Y.4,600,000, of which Tokyo's share is Y.3,100,000 and Yokohama's Y.1,500,000. The National Government will contribute one-fourth of the costs allotted to Tokyo, one-fourth of the repairs to the Yokohama Municipal hospital, one-third for the Contagious Diseases Hospital and one-half of the cost of the Tubercular Hospital, estimated at Y.700,000, Y.450,000 and Y.350,000 respectively. In addition, the national treasury will advance the sums necessary each year to cover the deficiency on interest charges of the loan bonds to be issued for covering the municipal government's share in the construction expenses.



Federal Two-Ton Dump Car, used by the Road Improvement Bureau of Tokyo Municipality

The Bridges of Tokyo

PRE-EARTHQUAKE TOKYO held the world's record for the number of bridges within municipal limits, mostly flimsy wooden structures designed for light foot passenger and cart traffic. The repeated conflagrations which swept over and destroyed the old picturesque tinder-box capital of the Shoguns so many times during the past three centuries were invariably accompanied by great loss of life, due to the inability of the people to escape from their water-surrounded districts. The old city was a veritable death-trap. Yet the people of Tokyo rebuilt their homes and shops in the same old flimsy cardboard fashion and restored the wooden bridges which at the next conflagration once more automatically closed their only avenue of escape and locked them in to face death in the roaring hell from which only the strongest escaped. As it was in the past, so it was in the great earthquake of 1923, although by this time many new steel and concrete bridges had been erected over the principal avenues of traffic and opened a way for people to escape. Hundreds of the old wooden bridges, however, still remained, and when they failed as a result of the quake or were consumed by the devouring flames, thousands of people were cut off from escape and perished miserably in the flames. Many times the people of Tokyo have paid the price for their neglect to properly protect themselves, and with the last great sacrifice fresh in their memory, have determined that never again will they be caught like rats in a trap during a conflagration; so in addition to the other modern improvements for remaking the city, all new bridges will be of steel, stone or reinforced concrete.

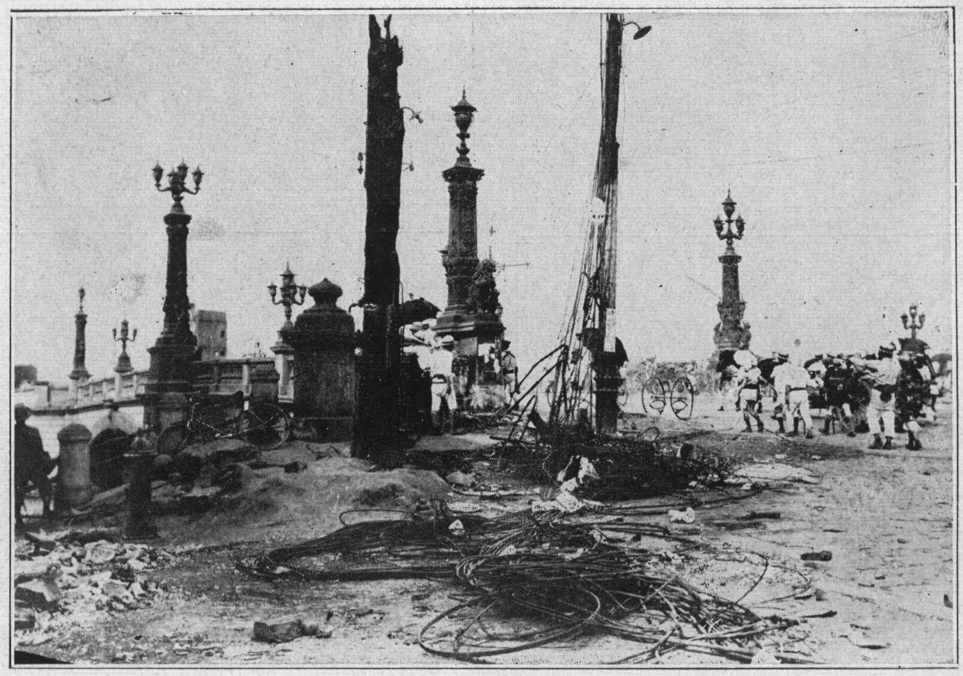
When Tokyo was organized as a Municipality in 1869 almost all the bridges, numbering 298, with the exception of the iron bridges over the Sumida River, were constructed of wood. The rapid increase of river and canal traffic to a point where more than 60 per cent. of the Municipal freight traffic was carried by water, compelled the erection of many new bridges. In 1922 there were 583 such structures, classified into 47 iron, 189 stone and 347 wooden bridges, covering an area of 24,183 *tsubo*. Besides these, there were 309 private bridges open for general traffic. The development of surface car and motor truck transportation, coupled with the abnormal extension of the tramway lines, compelled the adoption of a bridge building program that would meet the new traffic requirements, and in 1921 the Municipal Assembly approved a project for the construction of the Eitaibashi and 16 other large bridges extending over a period of four years. Work on this program was well under way when the earthquake and fire presented the opportunity to the Government to lay out the new street system with an entirely new bridge-building program.

TRAPPED

All avenues of escape cut off by the collapse and burning of the Bridges, thousands were caught in the fire-traps of Tokyo. This photo was taken in the Honjo Ward. Here over 30,000 perished in one small open space, where they flocked for safety

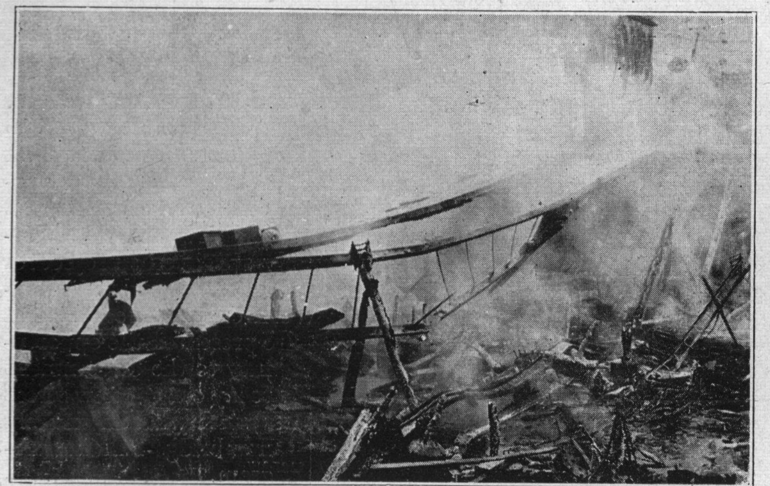
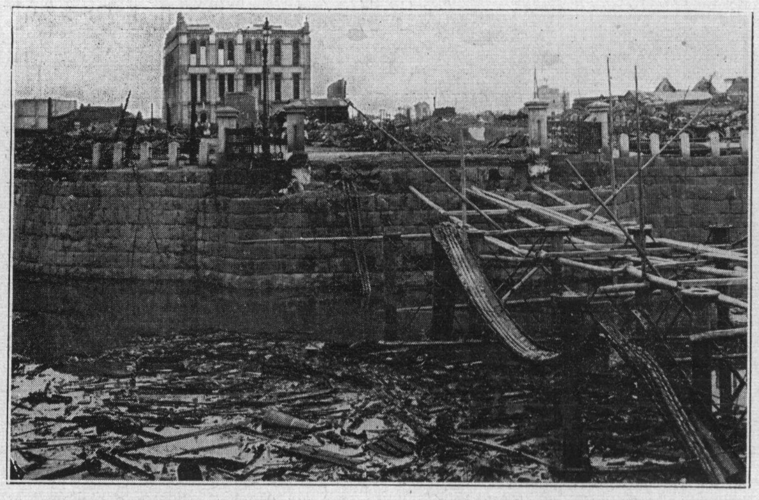
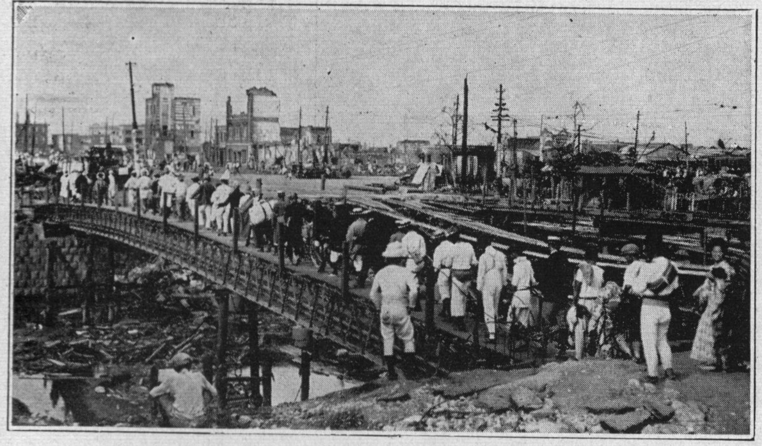
The names of the bridges of Tokyo are as familiar to the people of Japan as Wall Street, Broadway and Fifth Avenue are to Americans, as Pall Mall, Picadilly and the Strand to the British, and the Place de l'Opera or Concorde to the French. Nihonbashi, "The Bridge of Japan," is not only the center of Tokyo, but the center of the Japanese Empire, the starting-point for the measurement of distances. The present magnificent stone structure carrying the traffic of the Ginza was erected in 1912 at a cost of Y.524,000. Many of the wards and districts of Tokyo take their name from the main bridge connecting it with the next ward. Many of these bridges have the same significance as street addresses in other cities. Before the earthquake there were 675 of these structures. Of these, the earthquake shook down 69 and the fire consumed 289, about fifty per cent. of the total, amongst which were several of the important steel structures crossing the Sumida river and the principal bridges over the canals in the devastated wards of the capital. When the Reconstruction Bureau and the municipal and prefectural governments complete their new program there will be a total of 867 new bridges in the city of Tokyo.

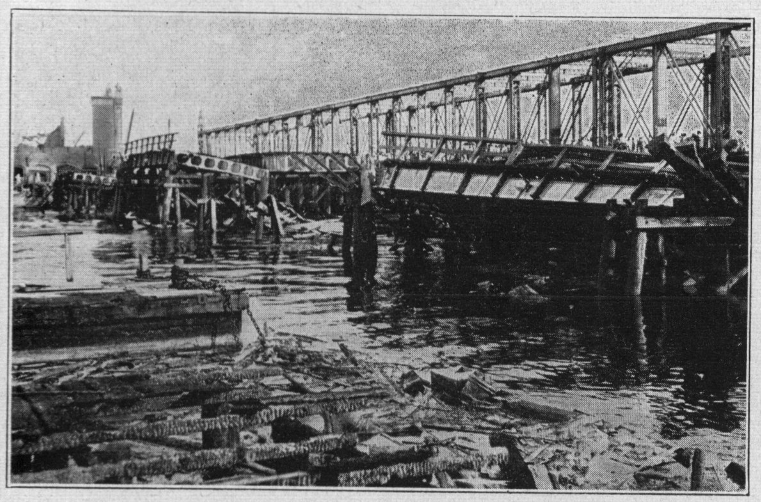
During the first reconstruction period (1923-1929) the Bureau will build 136 new bridges and the municipality and prefectural governments over 270.

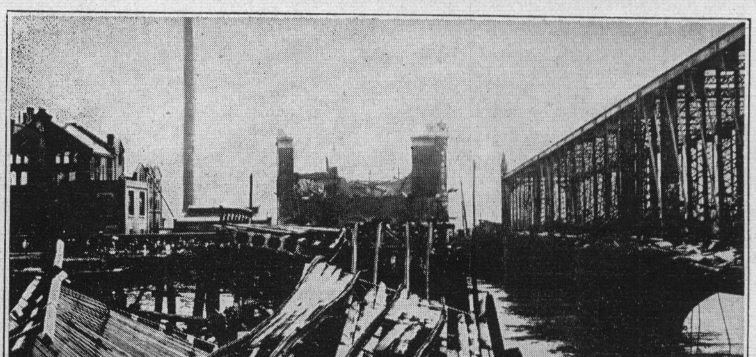


Nihonbashi, the Center of Tokyo, immediately after the conflagration

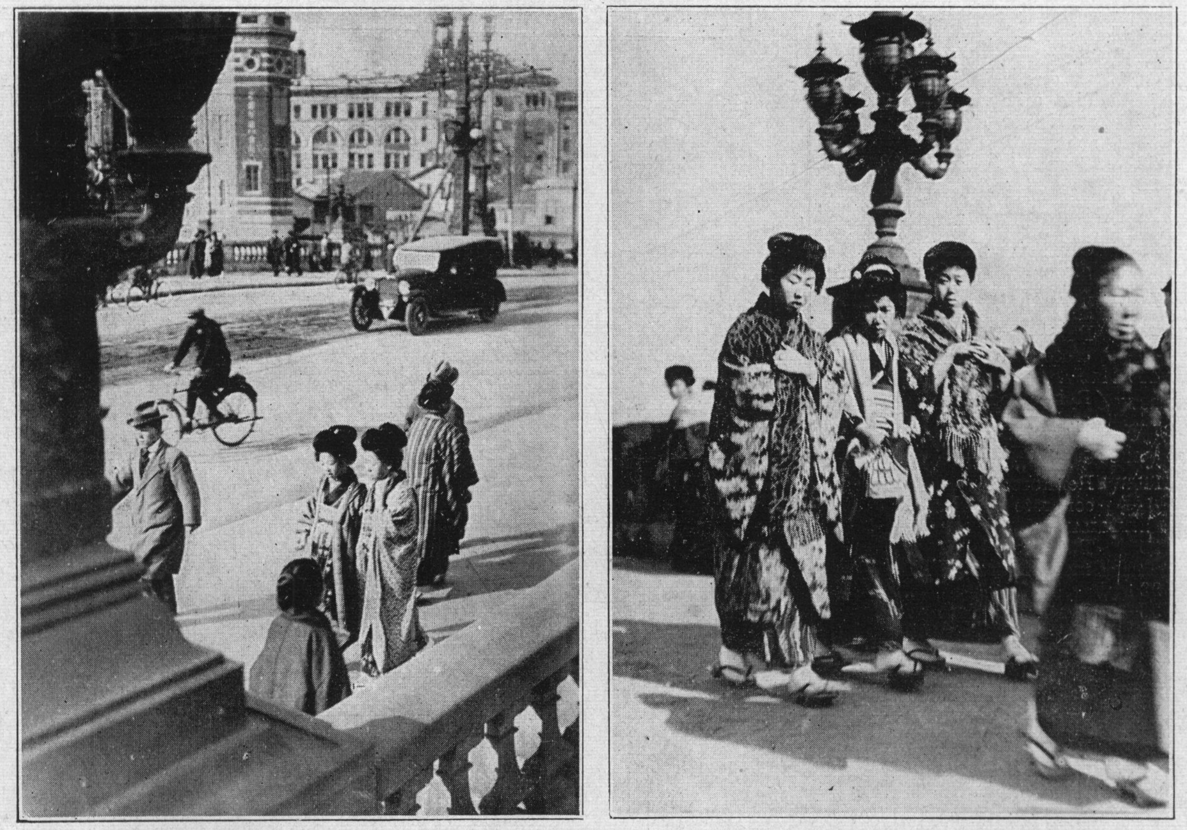
WHEN THE BRIDGES FAILED



Typical Scenes of Bridge Destruction by the Earthquake and Fire, Cutting off the Escape of the People from Death in the Flames.



Nihonbashi, The Bridge of Japan

The Reconstruction Bureau will build 118 bridges for roads of more than 22 meters wide, and 18 in connection with new canal construction. All bridges will be of steel, stone or reinforced concrete designed to carry 30-ton tram cars, 15-ton road rollers, and 15-ton trucks.

The most important of the new bridges are the six structures which will span the Sumida river, details of which are given in a separate article appearing in this number of THE FAR EASTERN REVIEW. The estimated cost of the 136 bridges to be built under the direct supervision of the Reconstruction Bureau is Y.34,000,000, of which one-third represents the cost of the Sumida river spans. The cost of the 330 bridges to be erected by the municipality and prefectures will be about Y.28,000,000, but at least half of this sum will be expended in emergency repairs to the old structures which later on must be entirely rebuilt of fireproof material.

Amongst the important new bridges in Tokyo are two of special design, one to be called the Hijiri Bashi, 80 meters long, and the other a 160-meter viaduct leading up to Kanda Hill. Another new bridge of special design called the Yaesu Bashi will connect the east side of the Tokyo Central Railway Station with the business districts of the city from which direct approach is now cut off by the railway yards and a drainage canal. This bridge will lead into a wide new thoroughfare cutting through the heart of Nihonbashi ward to the Sumida river.

The new Edo Bashi, spanning the Nihonbashi Canal near the Central Post Office, will be a 100-feet metallic arch structure. The Kanda Bashi, one of the important main street bridges, is being entirely rebuilt. The new Shimbashi, at the beginning of the Ginza, is a reinforced concrete arch, 80 feet long, a decided ornament to the business district. The majority of the other new bridges are to be constructed to standard designs under the following classification:

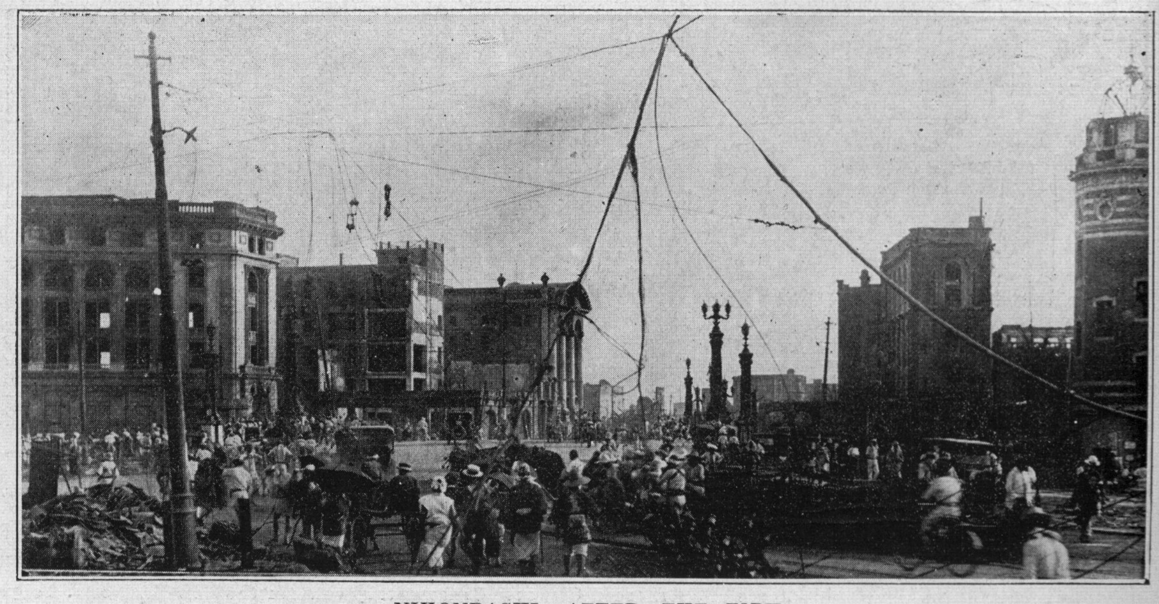
1. *First Class*:
   More than 360 feet long
2. *Second Class*:
   From 180 to 360 feet long
3. *Third Class*:
   a. from 150 to 180 feet long
   b. ,, 132 to 156 ,,
4. *Fourth Class*:
   a. from 108 to 132 ,,
   b. ,, 84 to 108 ,,
   c. ,, 60 to 84 ,,
5. *Extra Class*:
   all bridges under 60 ft. long.

Standard depths of Rivers and Canals: *First Class*, 15 feet; *Second Class*, 7 feet; *Third Class*, *a* and *b*, 6 feet; *Fourth Class*, *a* and *b*, 4 feet; *c*, 3 feet: *Extra Class*, 2 feet. The height of the lowest bridge beam is to be 3.5 meters above mean water level in order to provide ample clearance for barges loaded to a maximum height of 15 feet at low water. Such bridges are to be of the arch type with long street approaches.

The regulations provide that that the clearance between the lowest bridge beams and mean water level on the Arakawa and its brancles is to be 5½ meters, with 16.4 meters between piers. On the Sumida river the clearance in height is the same, with a minimum distance of 10 meters between piers. The width of many of the older bridges in Tokyo has been less than their street approaches, disorganising traffic at both ends. The new plans provide that all bridges under 180 feet in length are to be the full width of the street, and all longer bridges are to be two-thirds wider than the street.

As with every other phase of reconstruction, the bridge building program is being retarded and held up in many important places, due to the delay in settling the delicate and complicated property problems involved in the Land Adjustment or Replotting Plan. As a consequence of the rapid rebuilding of the city with temporary wooden structures the authorities have been compelled against their better judgment to erect temporary wooden bridges at various points in order to facilitate traffic.

The most important bridges to be built in Tokyo are as follows:

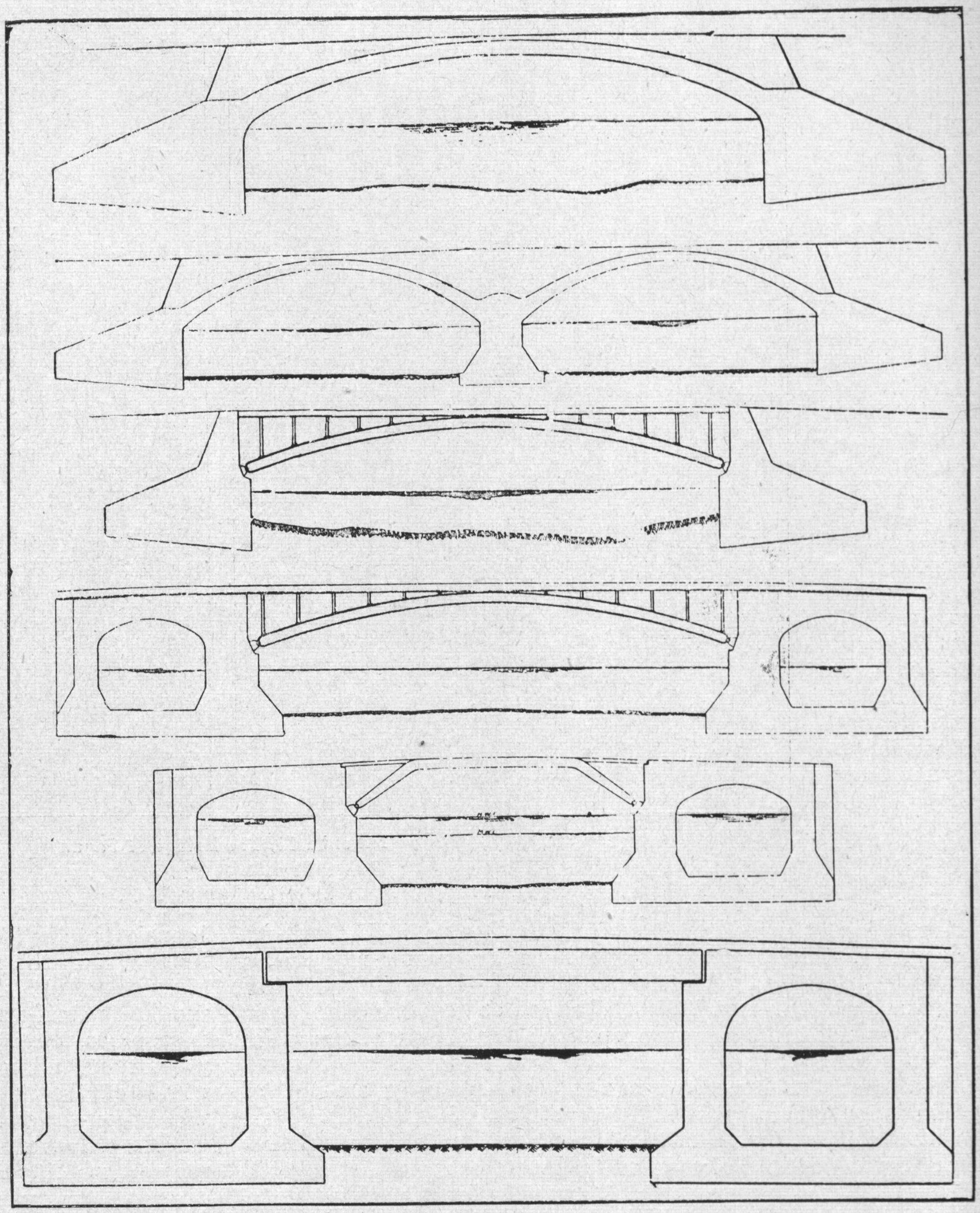


NIHONBASHI, AFTER THE FIRE.

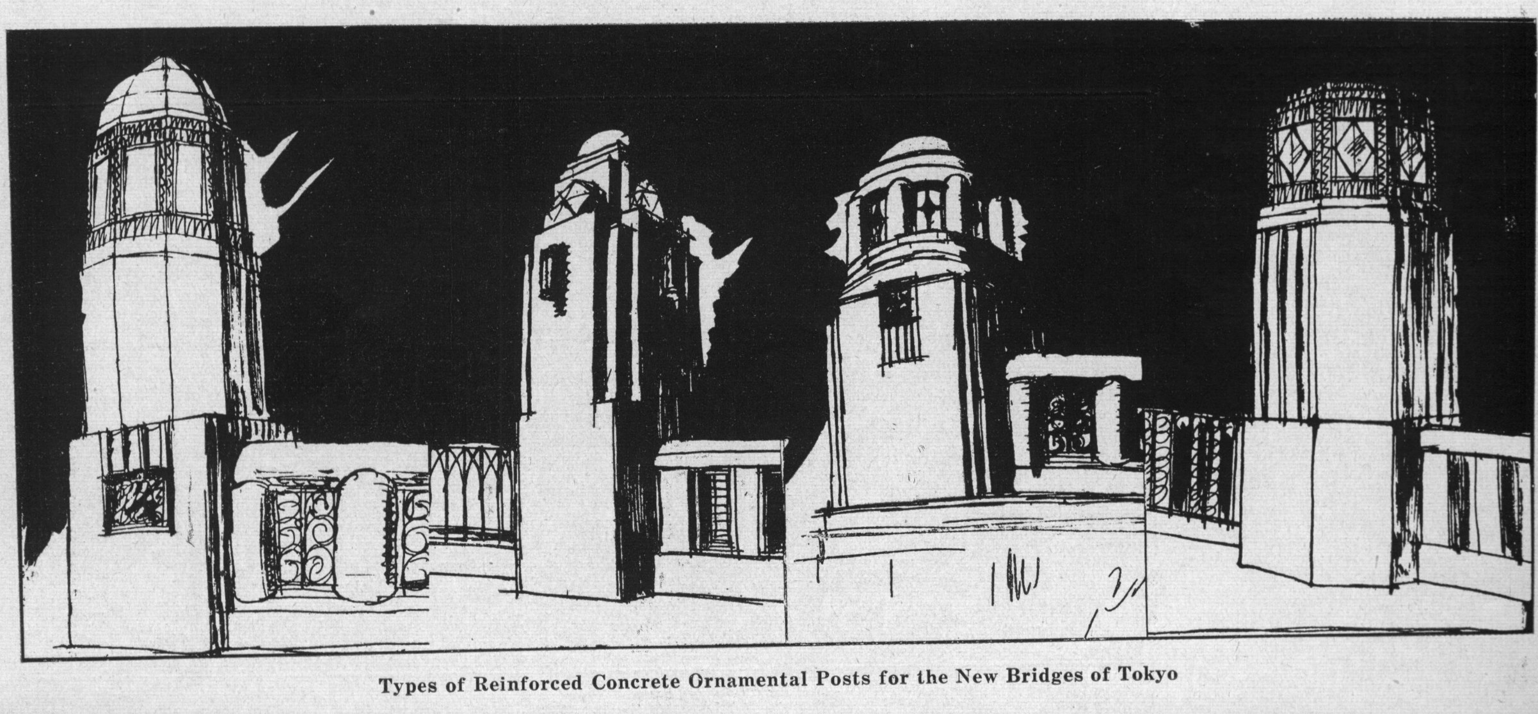
Murai Bank Morimura Building Imperial Hemp Co.

Name	Length. Meters	Width. Meters	Superstructure	Foundation
Aioi	191	22	Cantilever plate girder	Pile
Eitai	182	22	Tied arch with cantilever side span	Pneumatic caisson
Kiyosu	182	22	Suspension	,,
Kuramae	160	22	Two-hinged metallic arch	Pile
Komagata	150	22	,,	,,
Kototoi	145	22	Cantilever plate girder	Open caisson
Edo	63	44	Hingless metallic arch	Pile
Horai	35	44	Reinforced concrete arch	,,
Yaesu	38	44	,,	Concrete slab
Kanda	33	33	Reinforced concrete arch and plate girder	Well
Hijiri	92	22	,,	Pile
Sukiya	41	36	Reinforced concrete	,,
		YOKOHAMA		
Hagoromo	36	25	Two-hinged metallic arch	Pile
Senshu	28	22	,,	,,
Tsukiji	35	36	Cantilever plate girder	,,

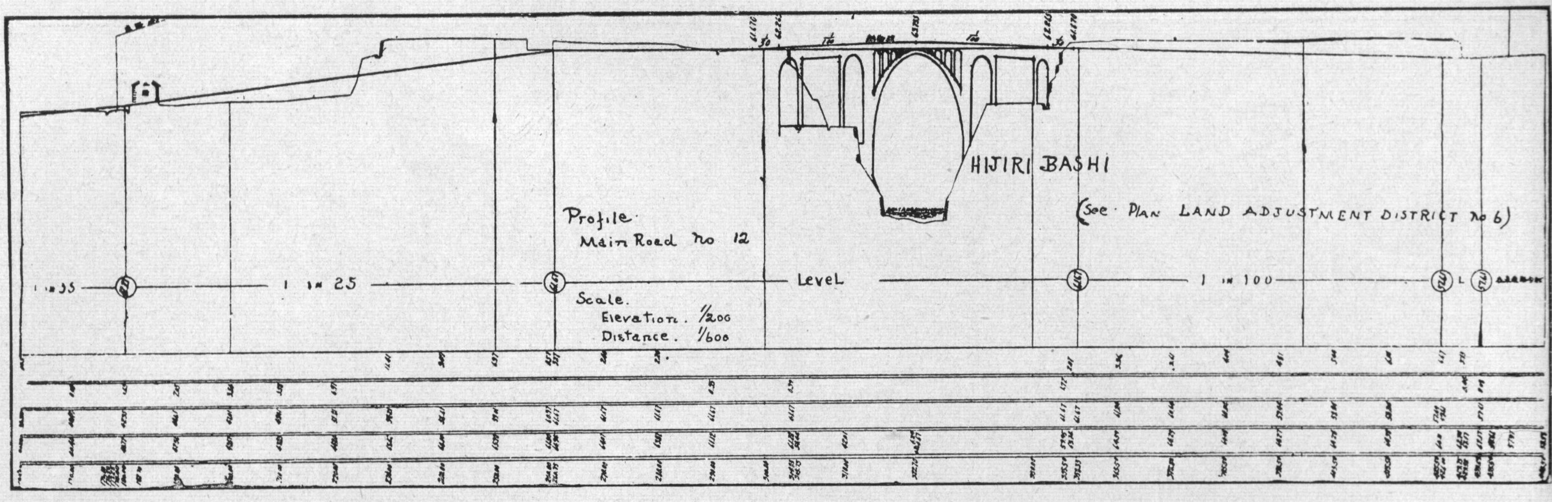
Practically all the material used in the construction of the many bridges in the new program will be purchased from Japanese manufacturers. The steel requirements have provided an opportunity for the domestic mills to dispose of their products at a fair price, though in the heavier spans, plates, reinforcing bars, etc., the Government has assured itself of the lowest prices by having the material purchased from the Government Steel Works at Yawata. The Kokura Steel Works and other establishments are furnishing the rivets, bolts and bars. In all, there will be about 40,000 tons of steel involved in the major bridge contracts. For the reinforced concrete structures over 400,000 cubic yards of gravel and sand and 200,000 cubic yards of crushed stone will be required, in addition to some 600,000 barrels of cement. The Japanese cement industry has advanced to such a high state of perfection and quality of product that all the cement requirements for the entire reconstruction program will be supplied by home manufacturers.

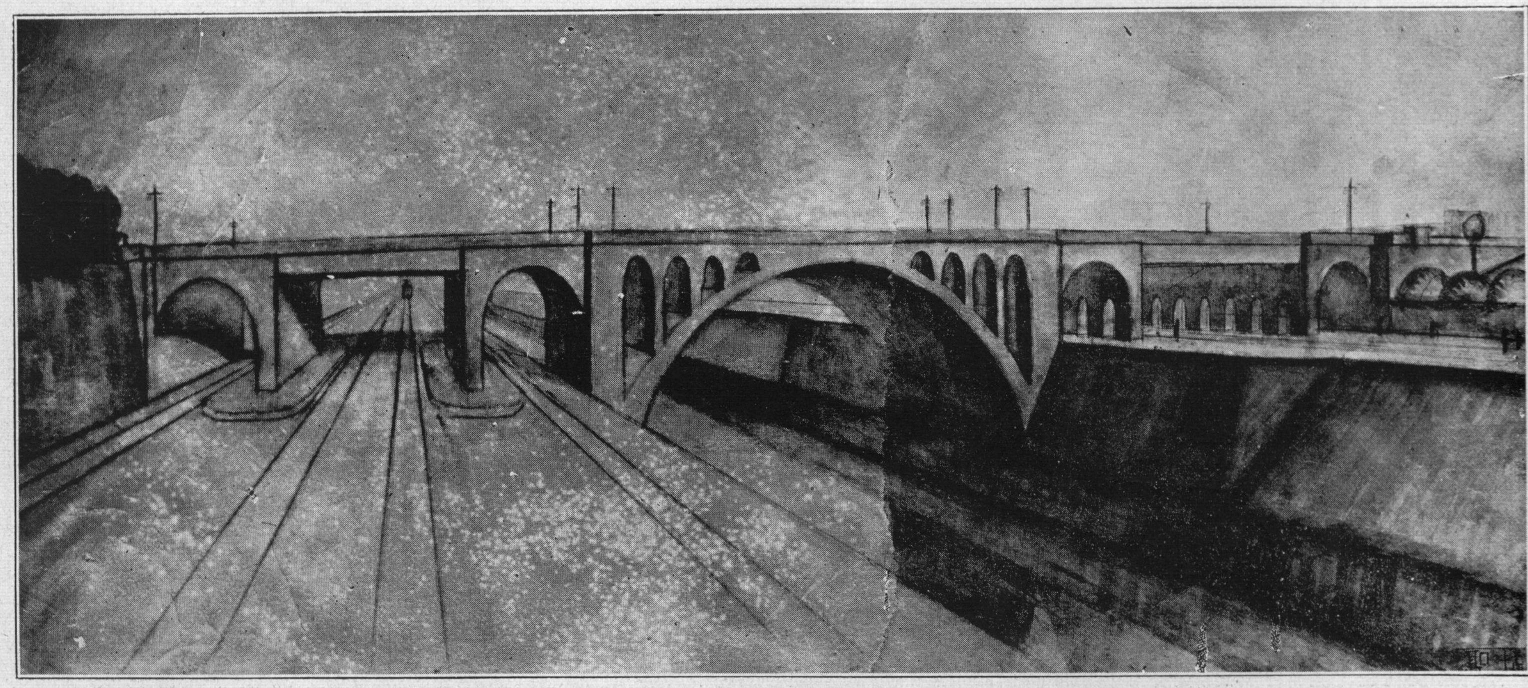


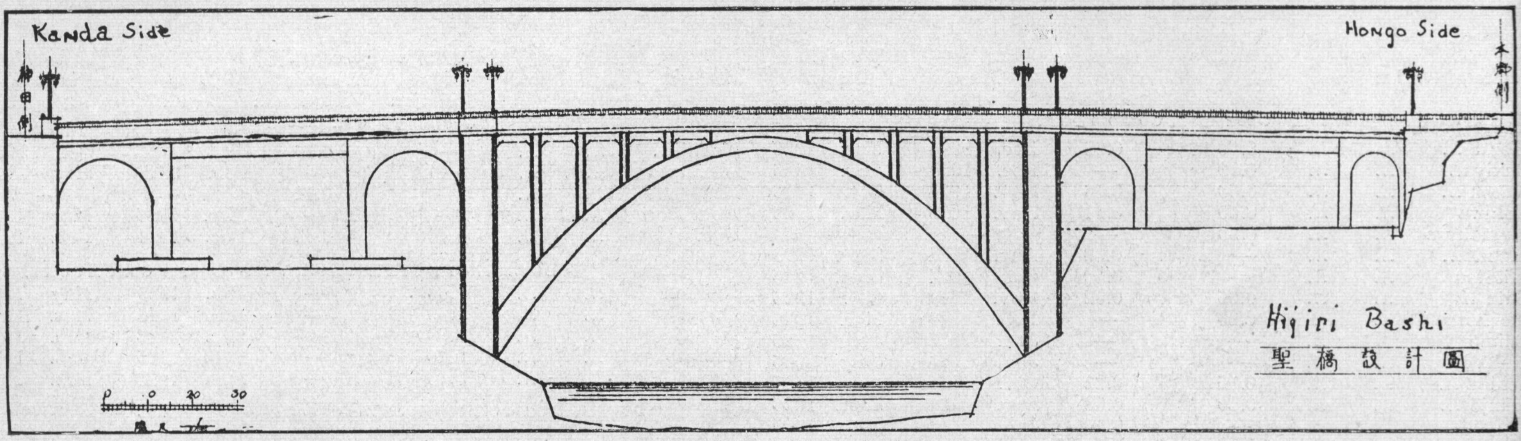
Types of New Concrete Bridges for the City of Tokyo. Top: Bridge near Tsukiji Market; Yaesu Bashi; Kondo and Iida Bashi; Yokohama, Shin Yoshida Bashi; Bottom: Chiyoda and Kando Bashi



Types of Reinforced Concrete Ornamental Posts for the New Bridges of Tokyo





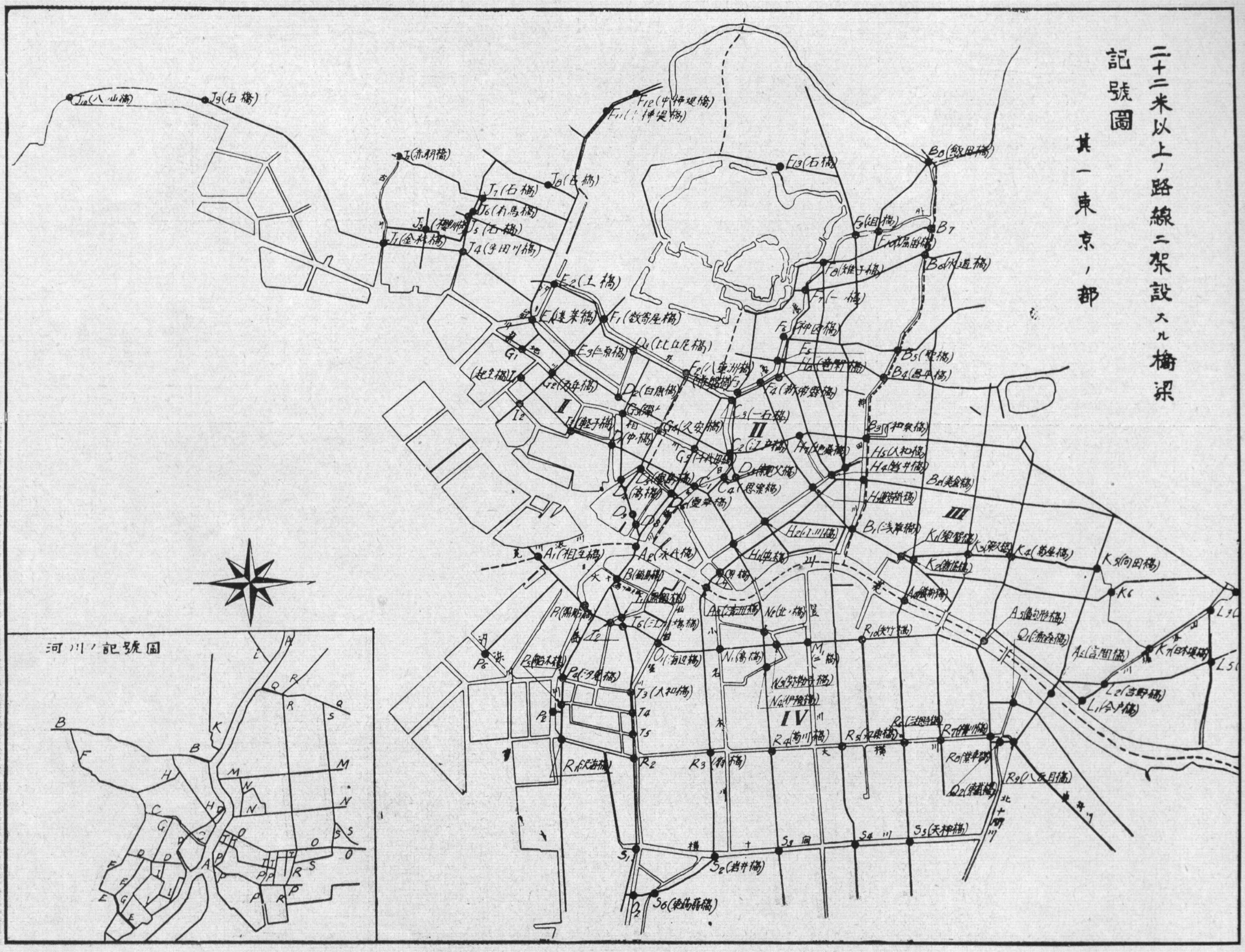


Hijiri-Bashi, one of the Finest Reinforced Concrete Bridges in Tokyo's Reconstruction Program, to be built over the Kandagawa Canal and the track of the Chuo Electric Railway by the Reconstruction Bureau

The following table shows the state of bridge construction in Tokyo at the end of December 1924:

Name or Bridge	Percentage of Appropriation Used	Percentage of Actual Construction Completed	Date Begun	Date Work is to be Completed
Aioi	—	0.17	Aug. 1924	Aug. 1926
Eitai	0.40	0.06	Nov. 1924	Dec. 1926
Kuramae	0.10	0.02	Sept. 1924	Oct. 1926
Komagata	0.70	0.07	Oct. 1924	Sept. 1926

Name of Bridge	Percentage of Appropriation Used	Percentage of Actual Construction Completed	Date Begun	Date Work is to be Completed
Hijiri	0.75	0.20	Sept. 1924	June 1926
Ichibei...	0.10	—	Feb. 1925	Mar. 1926
Edo	0.50	0.04	Dec. 1924	Feb. 1926
Oyaji	—	0.38	Sept. 1924	Sept. 1925
Bikuni...	0.10	—	Jan. 1925	June 1926
Otoko	0.80	0.23	Oct. 1924	Aug. 1925
Shirokane	0.60	—	Feb. 1925	Oct. 1925
Echizen	—	—	,,	Aug. 1925



Sketch Plan of Tokyo, showing Main Canals and Location of Principal Bridges. The black dots show the location of New Bridges to be built by the Reconstruction Bureau, and does not include the Municipal and Private Bridges

Name of Bridge	Percentage of Appropriation Used	Percentage of Actual Construction Completed	Date Begun	Date Work is to be Completed
Horai	0.50	0.02	Dec. 1924	Mar. 1926
Sukiya...	0.10	—	Dec. 1924	Mar. 1926
Yaesu	0.50	0.16	Nov. 1924	Oct. 1925
Tokiwa	0.50	0.11	Nov. 1925	Mar. 1926
Kamakura	0.60	—	—	—
Kanda...	—	0.53	Aug. 1924	Sept. 1925
Hitotsu	—	0.29	Oct. 1924	Sept. 1925
Shin Kiji	0.95	0.02	Nov. 1924	Oct. 1925
Horitome	0.20	—	Feb. 1924	Mar. 1926
Shimo Ryutei ...	—	—	Jan. 1925	July 1925
Naka Ryutei	—	—	Jan. 1925	July 1925
Ichiba	0.90	0.21	Oct. 1924	June 1925
Danjo	0.80	0.08	Dec. 1924	Sept. 1925
Chiyoda	—	0.54	July 1924	May 1925
Nakanohashi	0.15	—	—	—
Ogawa...	0.15	—	—	—
Kisho	0.70	—	Jan. 1925	Feb. 1926
Monzeki	0.70	0.10	Oct. 1924	Feb. 1926
Karuko	0.60	0.11	Dec. 1924	Mar. 1926
Kanasugi	0.10	—	Mar. 1925	Mar. 1926
Akabane	0.20	0.12	Jan. 1925	Mar. 1926
Shimbori	0.80	—	Jan. 1925	Sept. 1925
Eikyu	0.80	—	Jan. 1925	July 1925
Imado	—	0.08	Feb. 1925	Mar. 1926
Fukushima	—	0.04	—	—
Shiomi...	—	0.24	Sept. 1924	Aug. 1925
Funaki	—	0.07	—	—
Sawami	0.40	0.07	—	—
Momori	0.90	0.16	Dec. 1924	Jan. 1926
Kikugawa	—	0.29	Oct. 1924	Dec. 1925
Koto	—	0.23	Oct. 1924	Dec. 1925

Name of Bridge	Percentage of Appropriation Used	Percentage of Actual Construction Completed	Date Begun	Date Work is to be Completed
Hoonji...	—	0.30	Sept. 1924	Oct. 1925
Honmura	0.10	—	Feb. 1925	May 1926
Kurogame	—	0.11	—	—
Aburabori	—	—	Mar. 1925	May 1926
Ogibori	0.60	0.02	Dec. 1924	Feb. 1926

Bridges to be built in connection with Canal construction:

Naimon	1.00	—	Feb. 1925	May 1926
Owari	1.00	—	Mar. 1925	Mar. 1926
Hafuri	0.90	—	Feb. 1925	Feb. 1926
Kabuto	0.40	—	Feb. 1925	Feb. 1926
Renpei... ...	0.40	—	Feb. 1925	Feb. 1926

To be built in connection with Zoning system:

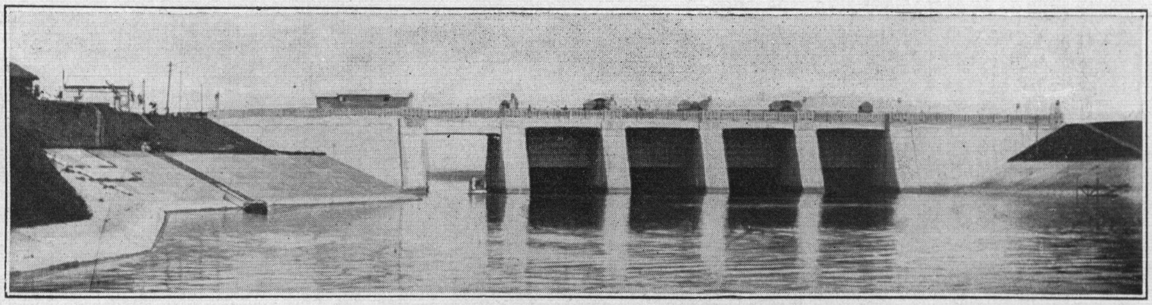
Nakamu	1.00	—	Feb. 1925	Feb. 1926

The following bridges in Yokohama are now under construction:

Shin Yoshiya ...	0.50	—	Mar. 1925	Mar. 1926
Hagoromo	—	0.10	Nov. 1924	Aug. 1925
Midori	0.75	—	Mar. 1925	Mar. 1926
Senshu...	0.75	0.28	Dec. 1924	Nov. 1925
Shin Nihonbashi ...	0.75	—	Mar. 1925	Mar. 1926
Suruga...	0.50	—	Mar. 1924	April 1926
Tsukiji	0.75	0.003	Feb. 1925	Mar. 1926
Kinko	0.75	0.08	Dec. 1924	Dec. 1925

Bridges to be constructed in Yokohama in connection with Canal work:

Hiraoka	0.50	—	April 1925	Mar. 1926
Numano	0.50	—	"	"

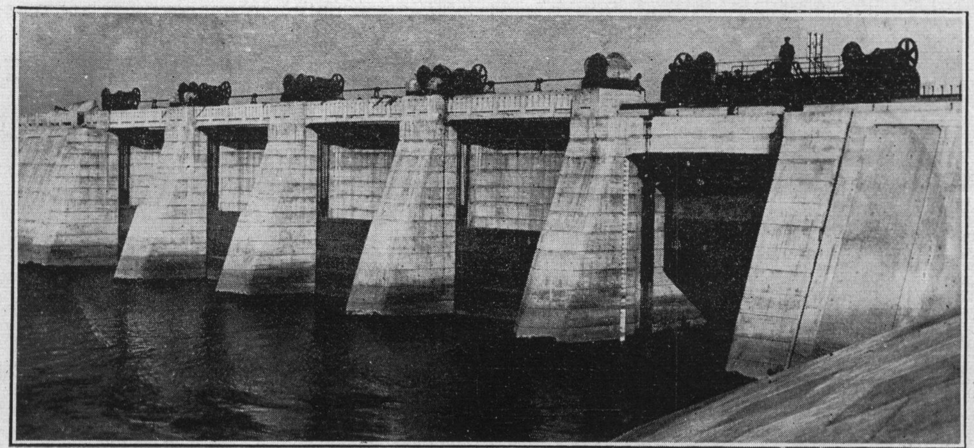


Iwabuchi Main Regulating Gates of the Arakawa Flood Prevention Works

The Arakawa Flood Prevention Works

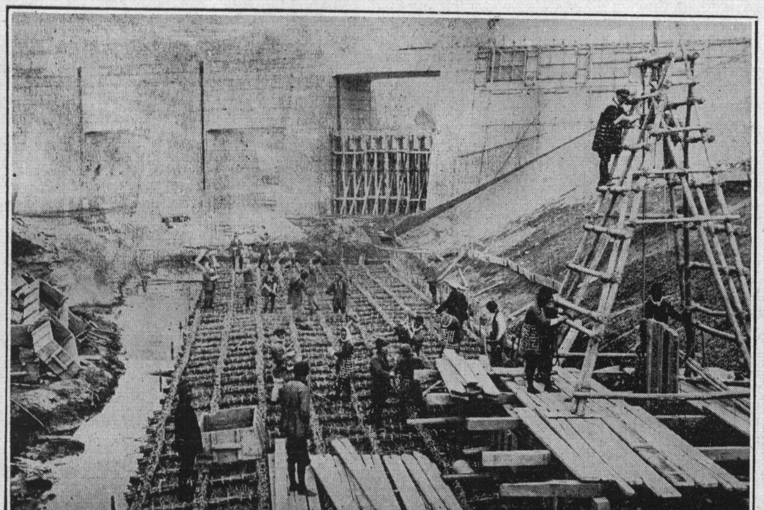
Cutting a New River Bed that Preserves the Lower Districts of Tokyo from Annual Inundation. One of the Most Important Engineering Undertakings for Safeguarding Lives and Property in the Metropolitan District

LIFE in old Yedo was full of adventure. Earthquakes and conflagrations varied the monotony of viewing the cherry blossoms and watching the daimyo processions go by, and to add to the excitement the Arakawa went off on an annual rampage of its own and swept the houses in the low-lying districts of the city out into the bay. Like the boulevards of Paris, the rivers, canals and streets in Japan change their name at the slightest provocation, and the Arakawa after it enters the city limits becomes the Sumidagawa. Ever since Tokyo was founded, the river has been a mixed blessing to the people, building up and tearing down as its vagaries seemed to warrant. The well-watered Kwanto plain, at the head of Tokyo Bay, is the richest district of Japan, and one of the reasons for Tokyo's rise to power and prosperity was the convenient inland water transportation afforded by the network of rivers, creeks and canals tributary to the two large rivers, the Arakawa and Tamagawa, emptying into the bay at this point. The total length of the Arakawa is only 107 miles, but with its branches it provides 330 miles navigable by lighters. In addition, over 200 miles of artificial canals have been dug to connect the main streams of the system.

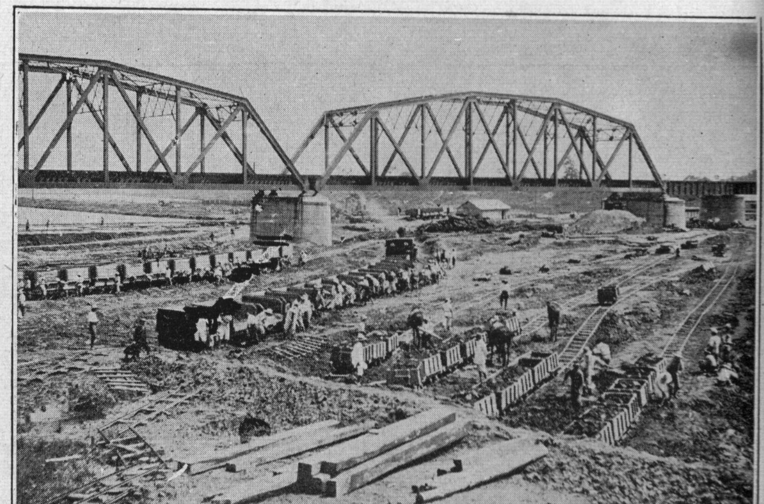


Down Stream View of the Iwabuchi Regulating Gates.

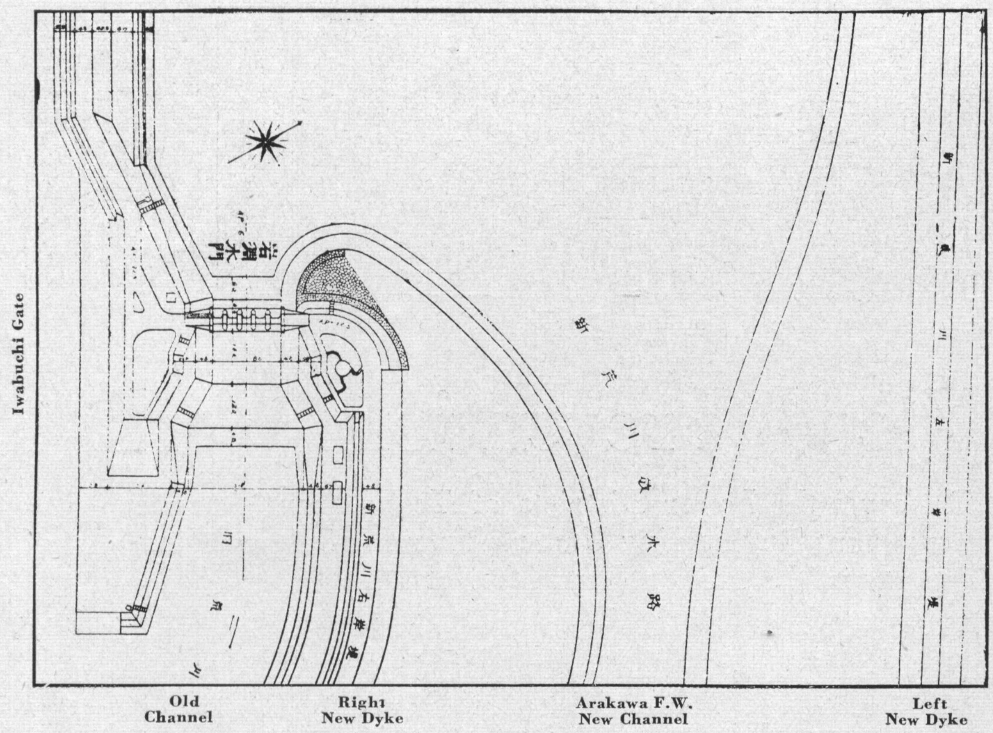
The most important of these rivers is the Arakawa, whose meanderings were looked upon by the people as acts of God, and nothing was ever done to control it. At its source, deep in the mountains of Saitama Prefecture, north-west of Tokyo, it is a harmless little mountain stream which widens out after two other equally peaceful rivulets add to its volume. At Kumagaya it becomes a real river. From this point to Kanegafuchi, north of Tokyo, it flows through peaceful fields for forty-three miles. Here it is joined by the Ayase river, and thereafter becomes known as the Sumida, passing through Tokyo and emptying into the bay. For thirty-five miles from the bay it is affected by the tide, and when a combination of high water and typhoon hits the Tokyo district the river just naturally spreads out over the surrounding country to a depth of many feet. Heavy rainfall back in the mountains and the Kwanto plain is followed by floods along the lower



Laying Brush Mattress Foundation for Cement Blocks above the Iwabuchi Regulating Gates.



Railway Bridge over the Arakawa Flood Water Canal near Senju.

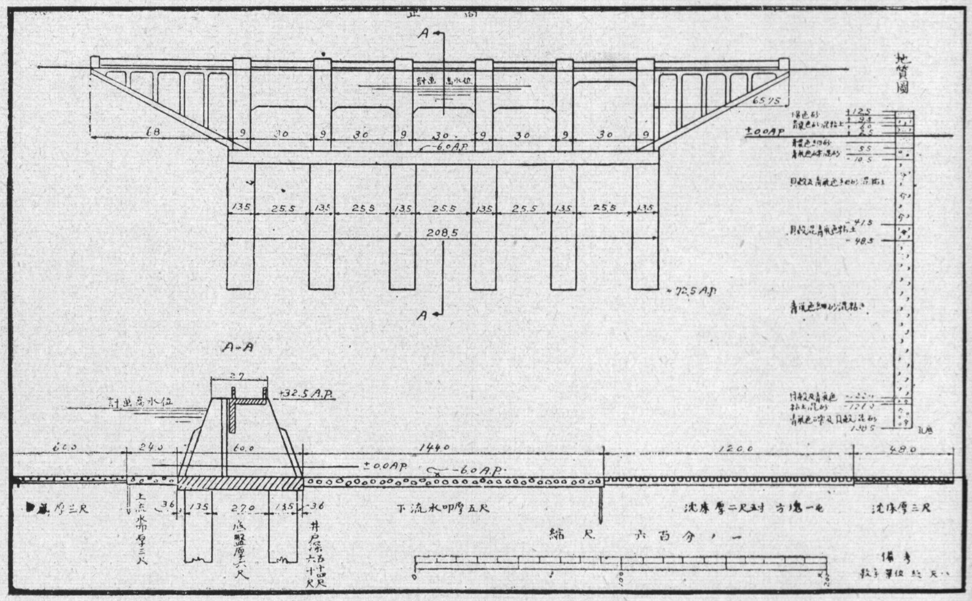


Plan of Flood Regulating Works at Iwabuchi

reaches of the Arakawa. In a period of 322 years there have been 132 floods, 68 occurring during the typhoon season. Several of these floods were national disasters of no less severity then the terrible fires and earthquakes which so often have overwhelmed the unfortunate city of Tokyo. The average annual loss during the Meiji Era (1868-1912) is calculated at over Y.2,000,000.

On the other side of Tokyo is the Tonegawa, another snow-fed mountain stream which rises to the distinction of being a real river when it reaches the Kwanto plain. During the rainy season it can usually be depended upon to work in close sympathy with the Arakawa, breaking through its embankments at the same time and inundating the eastern part of the city until the meeting of the two floods turns the district into an immense swamp. Since 1868 several attempts have been made to control these rivers, and up to 1907 more than Y.20,000,000 was spent in building embankments and sluice gates, but in 1907 it overflowed again, and in 1910, the last time the two rivers got out of bounds at the same time, Tokyo was cut off from the rest of the world for ten days. The entire industrial district was several feet under water and communication with Yokohama was maintained by boats. This catastrophe occasioned such an enormous loss that the Government finally decided that it was time to put into effect some permanent flood prevention scheme that would effectively control the Arakawa.

From the village of Hirakata to its mouth the Arakawa is 275 to 600-ft. wide at low water, spreading out to 3,000 and 9,000 in places at high water, causing great damage to the many villages crowded along its both banks. From Iwabuchi to Tokyo the river had been dyked on the left bank only, the right bank opening into the fields, which it flooded for miles. The new flood prevention scheme approved by the Diet in 1910 provided for the digging of a new channel for the Arakawa, starting at Iwabuchi and running along its left bank for a distance of five miles to Nishi Arai. At Motoki the stream is divided and a new river bed excavated as far as North Senju there crossing the Ayase river, thence to the Koyase river and south-east to the Kine river. It then crosses the Nakagawa and on south to the east bank of the Komatsu river down to the mouth of the Nakagawa, a distance of ten miles. From Motoki this new river bed will

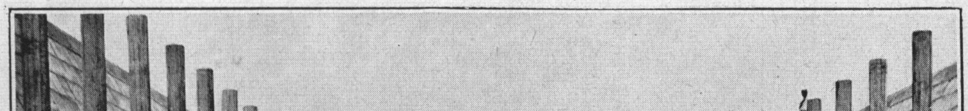


Section of Iwabuchi Gate.

carry off the flood waters of all the streams, discharging into the bay to the east of the Fukagawa Ward.

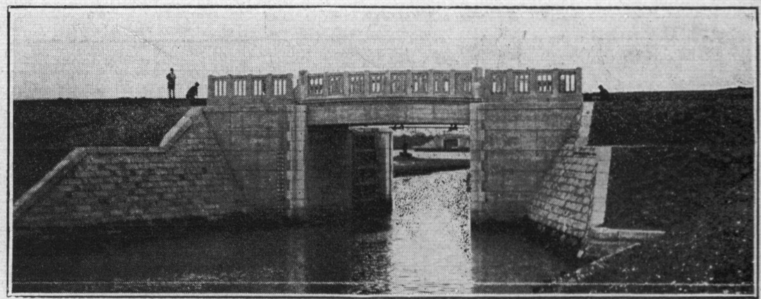
This great work, now practically completed, constitutes one of the great engineering feats for safeguarding the capital against further floods, and permits the development of the Honjo and Fukagawa Wards into comfortable factory districts and residence quarters. The divergence of these flood waters into the new canal relieves the Sumida of the vast volume it was formerly called upon to carry, and permits the practical closing of one of its mouths by reclaimed land for industrial sites. The added volume flowing out into the bay through the channel between Tsukujima and past the Shibaura wharves will tend to scour and keep the channel open for large ships.

Investigations at the time of drafting the plans for regulating the Arakawa showed that in 1907 the greatest flow per second at



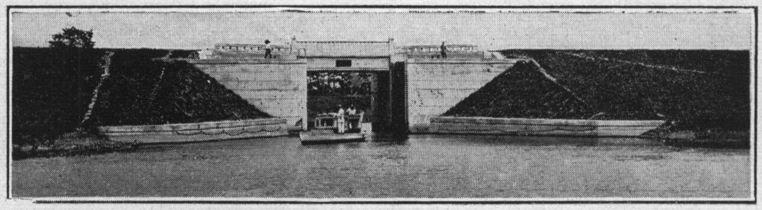
Onagigawa Lock; Under Construction

Shibaura Culvert



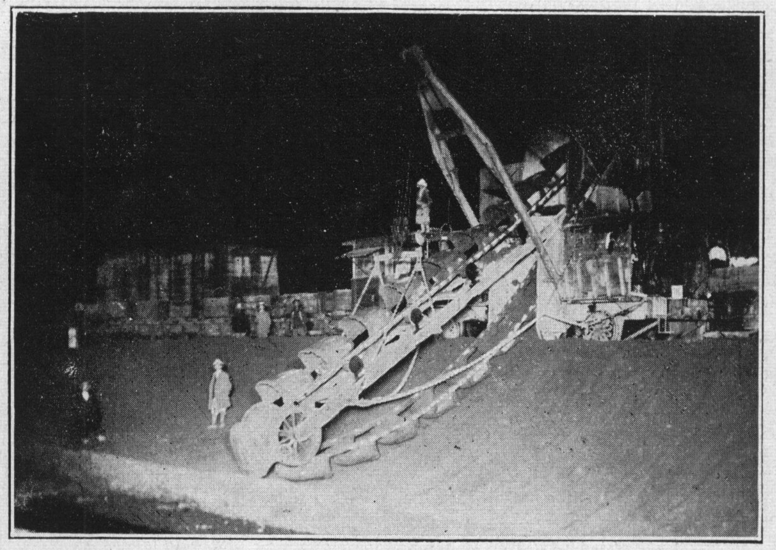
Kinegawa Sluice Way.

Iwabuchi was 150,000 cubic feet, but in 1910 this record was broken by a flow of 200,000 cubic feet. It is at this point that the main regulating gate, the most important feature of the flood prevention works, was located. It is intended to regulate the flow from the main river into the old Arakawa or Sumida channel to 30,000 cubic feet per second at low water and provide a constant depth for vessels which navigate the Sumida. It consists of five gates, each thirty feet wide, the right gate always remaining open for boat traffic.



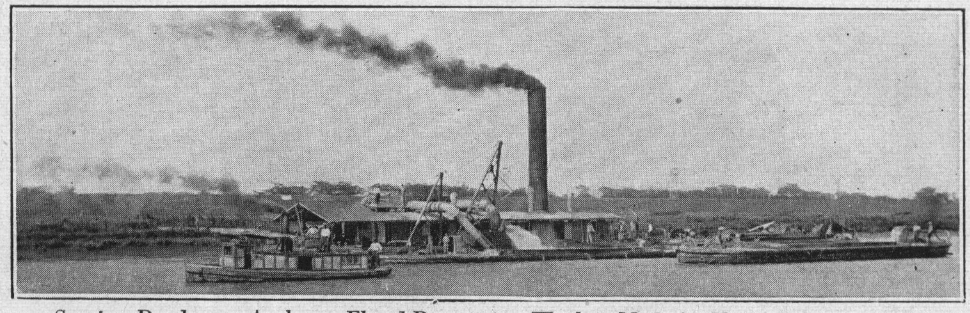
Ayase Sluice Way.

The foundations for the piers and abutments, six in number, are built on a row of six caissons, two under each pier and abutment. Each caisson is 13½-ft. square, 60-ft. long, with walls 2½-ft. thick down to 42-ft. and from there on 3-ft. thick. These caissons are filled with concrete, and over them is laid a bed of concrete 6-feet thick, on which the piers and abutments are built. These are 9-ft. wide, 60-ft. long, and spaced 30-ft. apart, supporting the water gates made of four horizontal and six vertical steel beams covered with ¾-in steel plates. The gates are 31-ft. wide and 15-ft. high, weighing 30 tons each, opened and closed by electric motors operated by an oil-generating set installed at the works.



Excavator at Work on New Arakawa Flood Prevention Canal: Made by the Niigata Iron Works.

The water apron leading under the gates is laid with cyclopean concrete 6-feet thick for a distance of 60-ft. on the down-stream and 24-ft. on the upstream side. The next 120-ft. on the downstream side is laid with concrete blocks on a brush mattress. The gate was completed in March of last year at a cost of Y.1,198,000.



Suction Dredge on Arakawa Flood Prevention Works: Made by Uraga Dock Co., Ltd.

The new flood prevention canal, or the Shin Arakawa (new Ara river) as it is called, is 1,500-ft. wide between the Iwabuchi Gate and Sumida Machi, a distance of seven and a half miles, and from this point to its mouth it gradually widens until it reaches 1,920-ft. In this main bed a stream from 180 to 840-ft. wide will be kept flowing at all times on a slope of 1-5,000, making possible a discharge of 120,000 cubic feet a second.

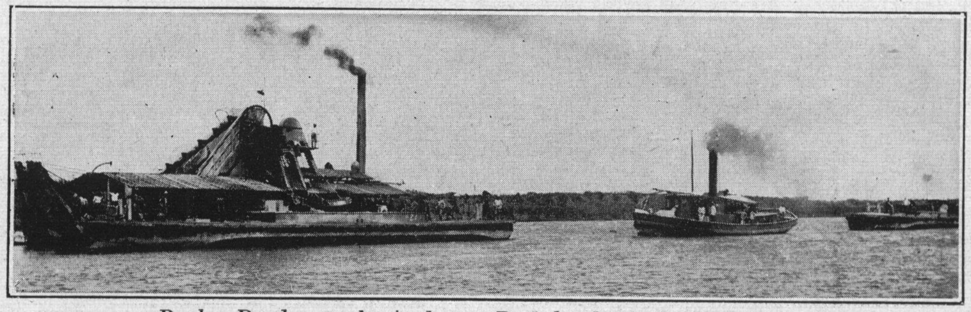
The old Arakawa between Iwabuchi and Senju is 316-ft. wide, widening to 480-ft. at the Azuma Bridge in Tokyo. This old river bed has been improved and dredged so that it now carries a regular flow of 30,000 cubic feet a second, which will be its normal at all times, even in a flood.

Along both sides of the Shin Arakawa dykes have been erected to a height of 7-ft. above the highest recorded flood level. On the right bank the dyke is 48-ft. wide, and on the left bank 36-ft., with slopes of 20 per cent. on the channel side and 30 per cent. on the inside. A road twelve feet wide has been laid out 6-feet below the top of the dyke on the outside of both the banks.

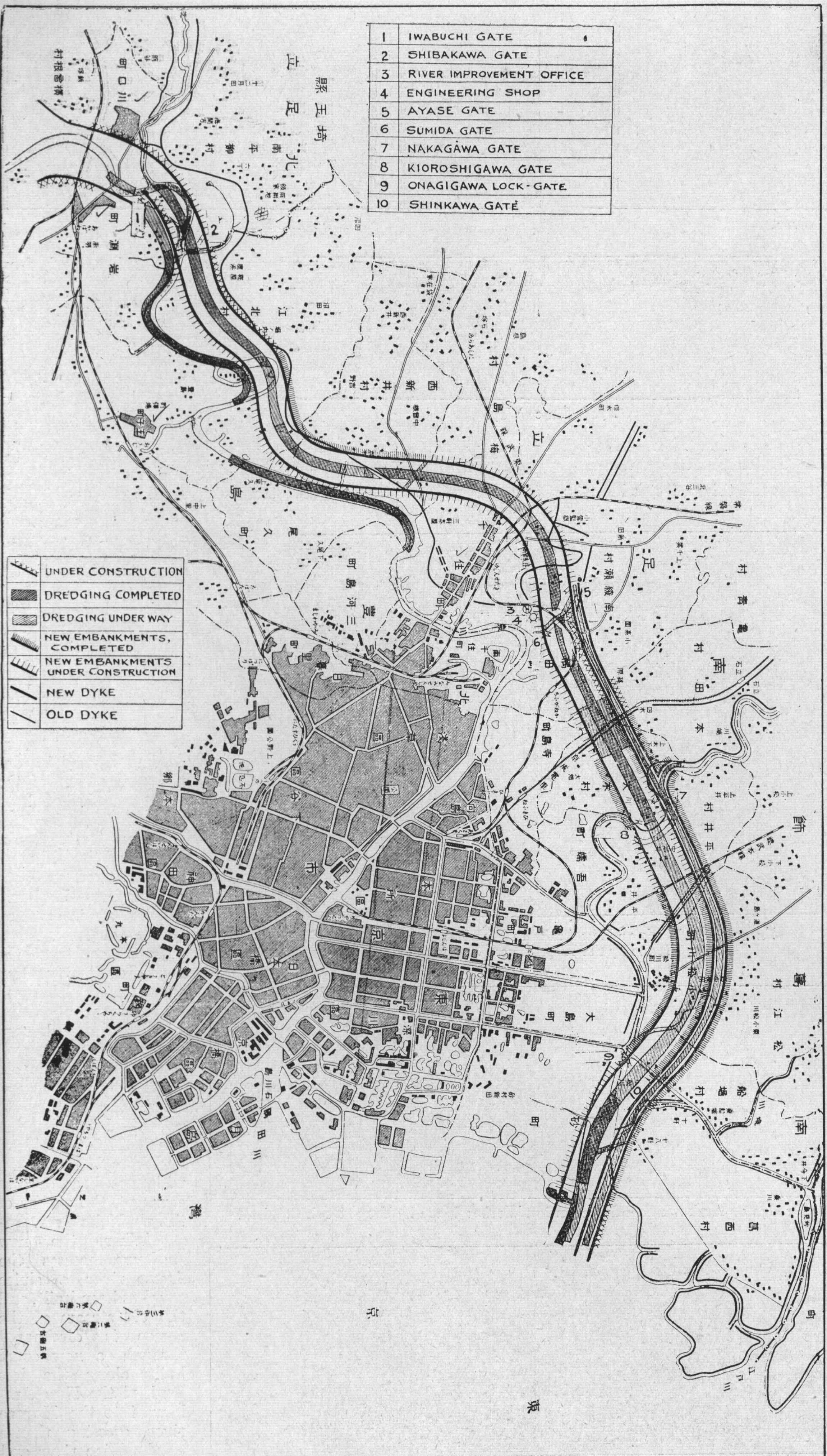
Where no protecting banks previously existed the old river has also been dyked on both sides, so that from Iwabuchi to the sea the river is confined effectively to its channel.

In order to construct the new flood prevention channel, the Nakagawa was cut off at Kami Hirai, and a lock built at that point to permit traffic between the old Naka river and the new river. Paralleling the new Arakawa, another canal, 27,000-ft. long and from 240 to 540-ft. wide, has been dug to carry off the waters of the old Naka river.

Where the new Arakawa crosses the Ayase river a sluice way has been built, and the old stream of the Ayase is discharged through a new canal built along the left bank of the New Arakawa into the Koyase river, crossing thence to the Kine river and finally discharging into



Bucket Dredge on the Arakawa; Built by the Osaka Iron Works.



PLAN OF THE ARAKAWA FLOOD PREVENTION WORKS.

Showing the Course of the New Drainage Canal starting at Iwabuchi and Discharging into Tokyo Bay East of the City of Tokyo

the Naka river. On the left bank of the new river a sluice gate has been built to permit traffic to pass from the Kine river to the Edo river. To connect the Ayase river and the Sumida river four locks have been constructed, and with the arrangement at Iwabuchi providing a special waterway for the use of boats, a flow of traffic up and down all these important streams is established.

In the construction of the new beds for the Arakawa, Ayase, and Nakagawa, 3,300,000 cubic *tsubo* (*tsubo*=216 cubic feet) were excavated, of which about 1,657,000 cubic *tsubo* was used to build the embankments. Excavations on the upper level were carried out by hand labor and on the lower levels by machinery.

The final improvements of the lower stream of the Arakawa will be completed in 1927 at a cost of Y.29,144,000. The effect on the prosperity of Tokyo will be inestimable, while upstream from Iwabuchi, where the flood water will no longer be able to back up and inundate surrounding fields, the towns and country will also be greatly benefited.

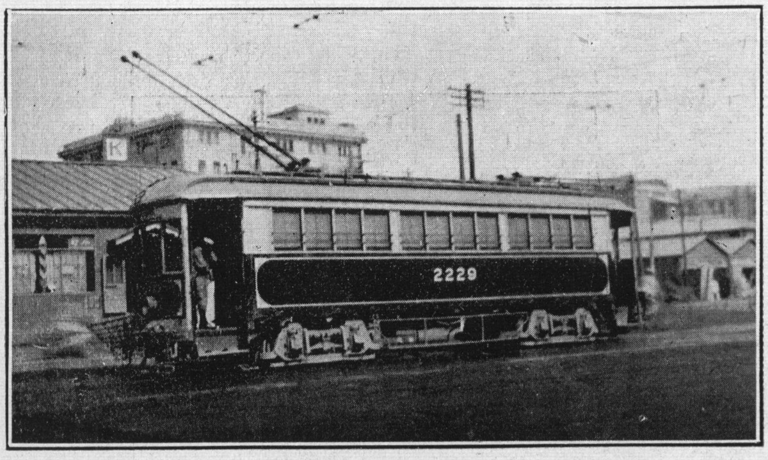
The new channel shortens the distance from Iwabuchi to the sea by one-fifth, thus permitting the discharge of the upstream flow in a greatly lessened time than before. In the past the discharge of the Ayase river has backed up the flow of the Sumida, but now that this river discharges into the sea through an entirely new channel this cause of loss has been for ever done away with. As a result of joining the Ayase, Naka and New Ara rivers the industrial districts of Honjo and Fukagawa are now better provided with transportation facilities by water than ever before.

The Arakawa flood prevention works is considered by experts to be one of the most important pieces of engineering work ever undertaken in Japan, not so much because of its engineering difficulties, but because of the favorable effect its completion will have on the industrial development of the capital and the surrounding territory.

Tokyo's Tramway System

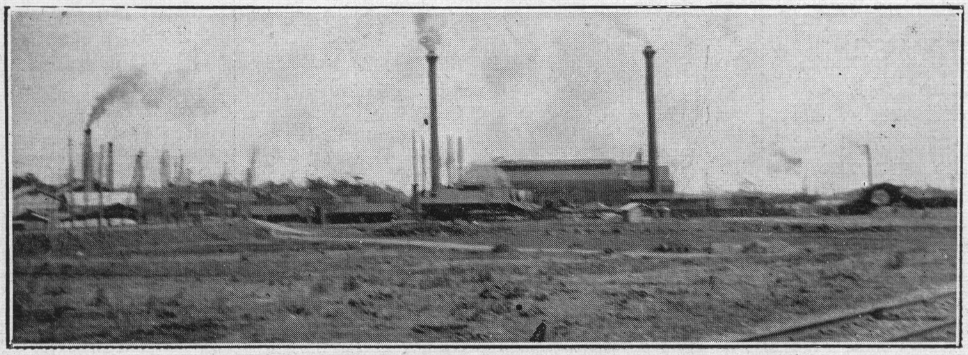
With Nearly 200 Miles of Track and 1,400 Cars the System Cannot Be Extended Rapidly Enough to Meet the Growing Transportation Demand

IT was not until 1911 that the surface tramways of Tokyo were taken over by the city from the Tokyo Railway Company, which at that time operated 119.5 miles of track, under a franchise which covered rights to about 200 more miles. The traffic requirements of the city seemed to grow farther than new lines could be constructed, and in order to meet this demand, and provide adequate and efficient service, many changes were carried out, which, together with new construction, temporarily helped to relieve the traffic congestion. The extension of the surface lines out to the city limits was followed by an immediate and rapid development of the suburbs. This growth has continued to the extent that the surface lines are no longer capable of providing rapid transportation for these new districts, and as a consequence, the elevared electric lines of the Imperial Government Railway Department now handle a large percentage of the long haul traffic that pours into the city from the private suburban lines, while several motor services have also been placed in operation in order to relieve the pressure.



New Type of Car for the Tokyo Municipal Tramways

Ten years after taking over the tramway lines (1921) the Tokyo City Electric Bureau had increased the track mileage to 183.3, operating 926 bogie and 795 four-wheel cars. In the fiscal year ending March 31, 1922, the daily average of passengers carried was 1,450,231, with receipts at Y.95,935 from 1,427 cars running 130,570 miles a day. The system at that date represented an investment of Y.105,910,000, covered by municipal bonds issued on the domestic and foreign markets.



Shinagawa Power Station of the Tokyo Municipal Tramways

In 1918 the city was authorized to construct 86 miles of new lines before the end of 1925, the program being completed by March 1924. Further extensions are now necessary to cope with the demand for transportation, and all future construction will come under the general program of the Reconstruction Bureau.

In order to understand something of the task which has confronted the Electric Bureau since the earthquake, a brief description of the damages inflicted is necessary. With the first earthquake shocks the power from the Kinugawa generating plants, distributed to the city through the Konuma substation, was cut off. All the overhead trolley wires were more or less damaged, but fortunately were easily and quickly repaired. Of the 95 route miles of tramway in operation at the time, 49.6 miles were on streets in the burned district; and although the rails in general were uninjured, there was considerable damage in places where construction work was in progress and the ties not yet covered with concrete. In such places 27,410 ties were burned and the rails twisted like wire. A further 15,000 ties were destroyed in the storage yards. The greatest loss, amounting to Y.13,000,000, was in buildings, cars and supplies.

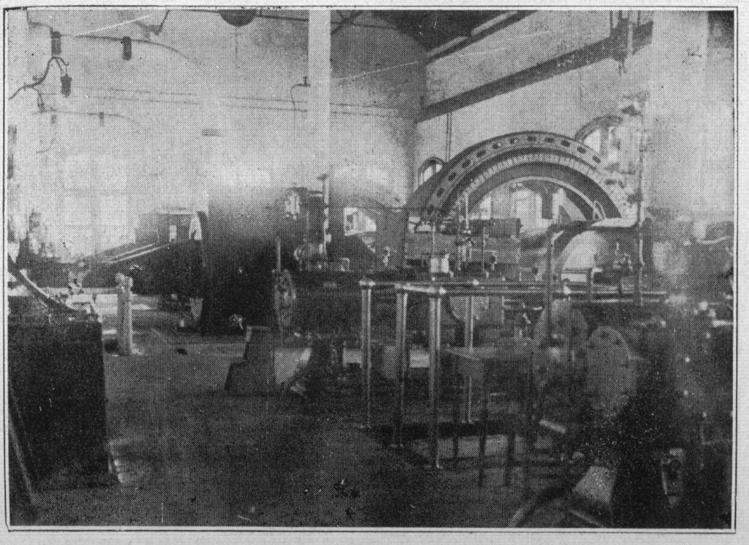
The wiring was hopelessly confused and entangled, but was brought into service again after slight repairs. The underground high pressure cables were uninjured, which made possible the rapid restoration of light and power in the unburned districts during the first week after the disaster.

Twenty-six minor bridges carrying tram lines were burned, while the destruction of the larger bridges across the Sumida river, cutting communication between the west and east of Tokyo, was a severe blow to the transportation facilities. With the help of the army, temporary structures were hastily thrown across the river and opened to tramway traffic by the end of October.

Of the 1,905 trams cars owned by the Bureau, 777 (509 bogie and 207 four-wheel) were destroyed by fire, 375 being burned on the tracks.

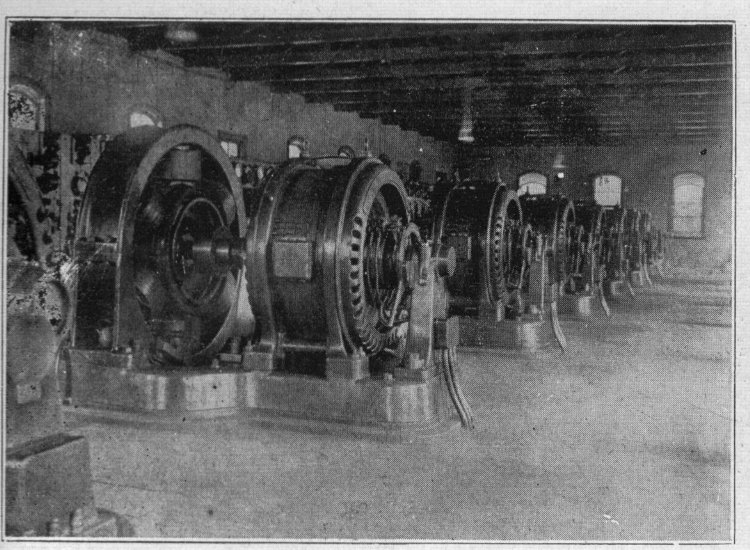
Only two out of sixteen transformer stations (Shirokane and Komagome) owned by the Bureau were undamaged. These were rapidly put in working condition and power supplied for lighting the city and running the trams during the first weeks of September 1923.

Wire supports were not damaged by the quake, although 288 were burned. All the 148 electric clocks just installed before the disaster at important tram stops and transfer points were put out of order, and the master clock and 66 others were burned.

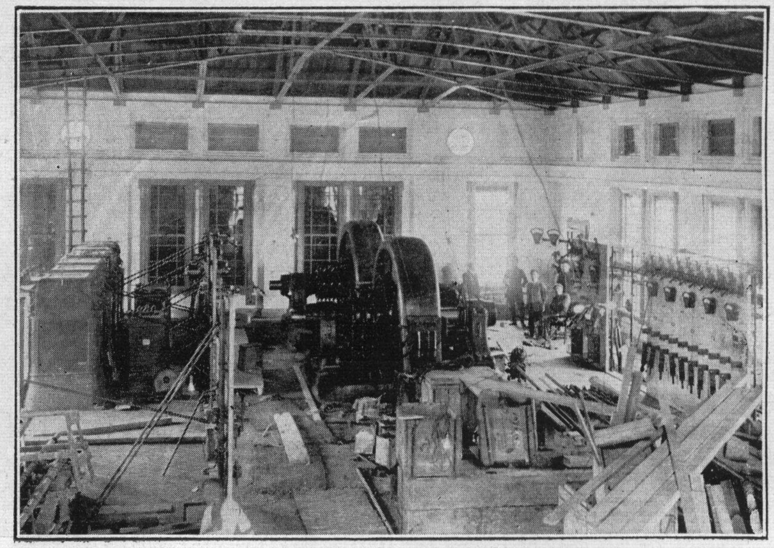


Interior of Shinagawa Power Station

The fact that the high tension transmission line was unharmed, and the two transformer stations at Komagome and Shirokane were speedily repaired, made it possible to

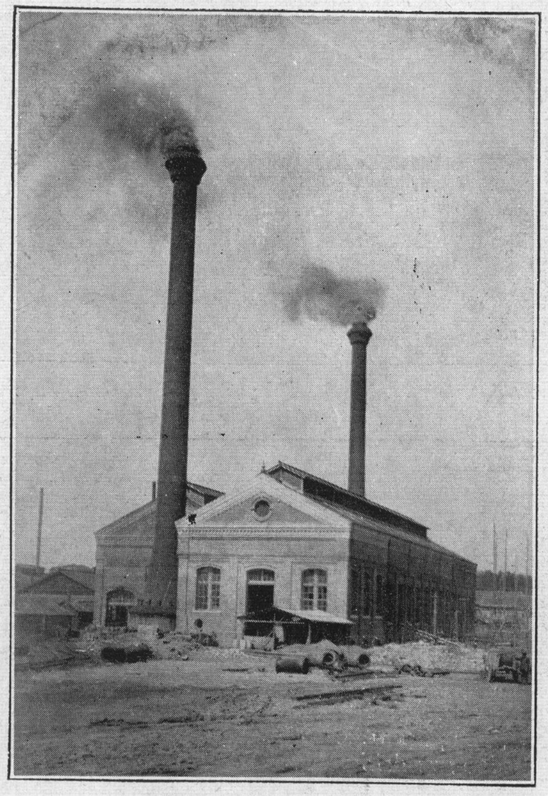


Yokonami Sub-station



Shitaya Sub-station

restore a measure of traffic normalcy to Tokyo before a week had passed. The Electric Bureau of Tokyo City was the pioneer in reconstruction work, and its subsequent efforts to restore its services to pre-earthquake conditions have been untiring. On the fourth of September current for lights in the unburned districts was turned on, and on the sixth the first trams were run between Shiba, Shinmeicho and Uyeno. Temporary bridges were constructed on the most important lines and the tangle of wires straightened out in the following weeks. The principal obstacle to the restoration of normal traffic was the loss of cars. Even by working all the car factories in Japan to capacity, new cars could not be delivered rapidly enough to meet the demand. However, by the end of June 1914, 470 new bogie trams were delivered. All material and parts of these cars, with the exception of the air brake equipment from the Westinghouse Air Brake Co., were made in Japan. Thirty air brakes made by the Knorr Bremsel Co., of Germany, were also bought for experimental purposes. The burned poles were replaced by Mannesmann steel poles, 23 to 26-ft. long, set 100-ft. apart and imbedded in concrete six feet below the street level. All poles which before the fire were set in the middle of the street were changed to the sides.

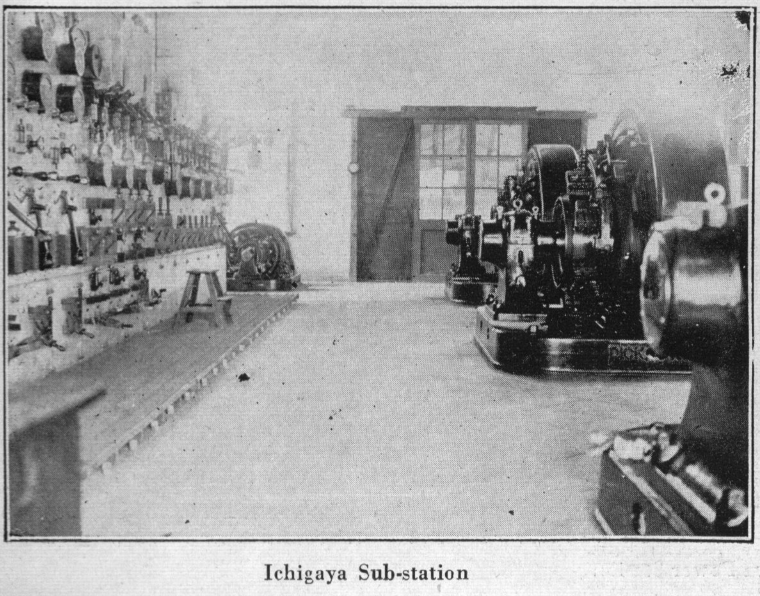


Shinagawa Power Station

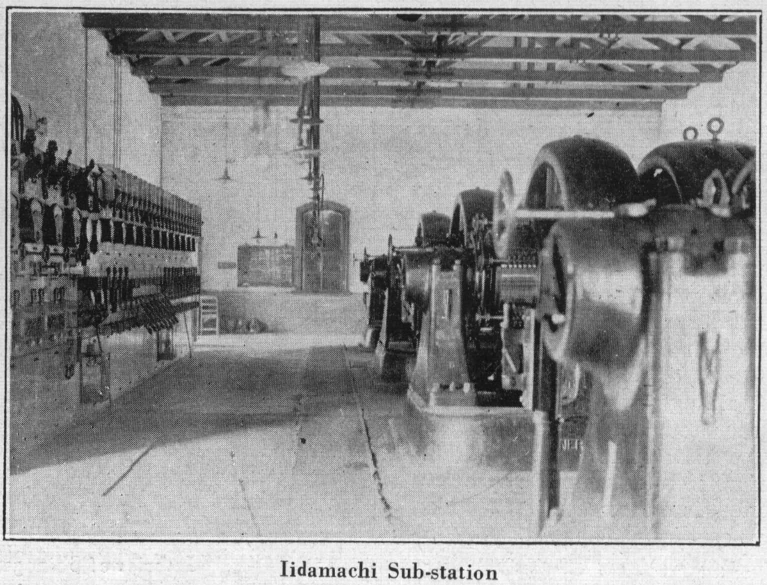
By the end of April 1924 repair work had so far advanced that 98.66 route miles, 195.15 track miles, and 23.5 miles of service track were again in operation. This is a slight increase in mileage, about 5/6ths of a mile, above that in operation on the morning of September 1, 1923. At the beginning of April 1923 there were 188 track miles in operation. So, despite the earthquake, 3.46 miles of new track were added to the system during the fiscal year 1923-24.

The following table, gives the tramway property owned by the Bureau on March 31, 1924, as compared to September 1923 :

	Sept., 1923.	Mar. 31, 1924.
Track :		
Route Miles ...	98.26	98.62
Track Miles ...	194.32	195.15
Service Track,	23.65	23.60
Bridges :		
Number ...	55	69
Area of surface	1,924 tsubo	2,389 tsubo
Wires :		
Trolley, 600 v.	1,038,439 feet	2,146,744 feet
High Voltage :		
Underground...	227,240 ,,	783,315 ,,



Ichigaya Sub-station

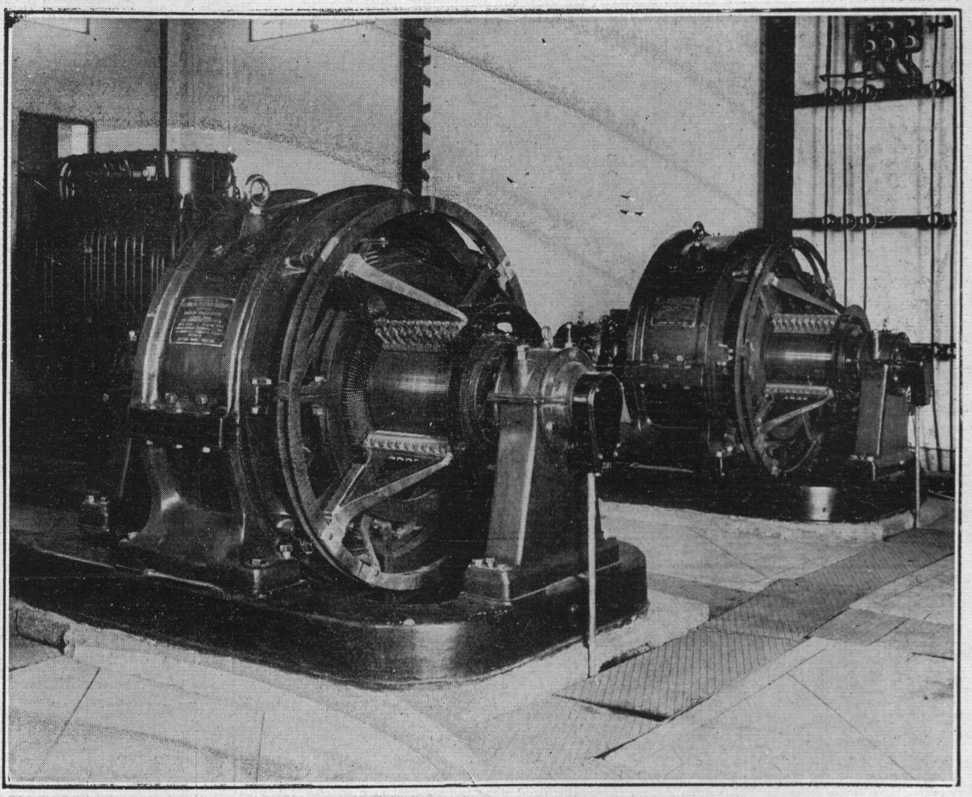


Iidamachi Sub-station

	September, 1923.	March 31, 1924.
Transmission Lines :		
Overhead, 600 v. ...	38,375 feet.	98,153 feet.
Underground, 600 v.	478,367 „	855,970 „
Supply Lines :		
Overhead, 110 v. ...	489,186 feet.	1,026,712 feet.
„ 3,330 v. ...	46,125 „	46,125 „
Underground, 110 v.	3,740 „	5,740 „
„ 3,300 v.	315,085 „	316,485 „

Thirteen of the sixteen transformer stations used by the tramways were destroyed. These were all rebuilt or repaired by the end of March 31, 1924. The equipment of these stations is as follows :

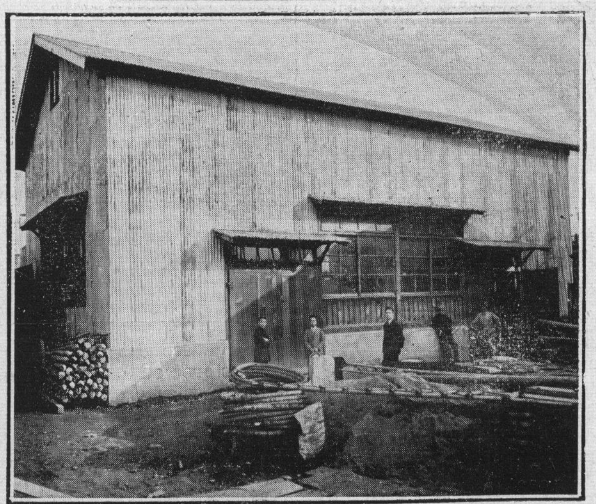
Name of Station	Rotary No.	Converters, Tower, Total	Transmission Switches No.	Circuit Breakers, No.
Ichigaya (Generators 3—330 k.w. each)				
Yuraku Cho ...	4	2,000 k.w.	48	162
(Also 2 Frequency changing condensers, 2,000 k.w.)				
Yokonami ...	3	1,200	21	24
Hamamatsu Cho	2	800	15	18
Shitaya ...	2	2,500	24	45
Kasuga Cho ...	4	3,000	16	36
Shinobu Cho ...	3	2,250	22	30
Shirokane ...	2	2,000	24	24
Tokiwa Bashi ...	2	1,000	15	30
Asakusa ...	1	750	12	33
Kasumi Cho ...	2	1,000	10	9
Kuroe Cho ...	1	500	12	21
Iida Machi ...	2	1,500	7	9
Komagome ...	1	400	13	21
Koishikawa ...	1	400	11	18
Konuma ...	2	1,000	7	6



The Tokyo Electric Bureau also owns a steam power plant for the use of the tramways, located at Shinagawa, equipped with (March 31, 1924) :

Boilers, 8, of 350 h.p. each ; Prime Movers, 3 of 1,800 h.p. each and 1 of 2,800 h.p.: Generators, 6,060 volts, 3 of 1,200 k.v.a. and 1 of 2,000 k.v.a.

The car shops at Hamamatsu Cho entirely destroyed by the fire have not yet been restored to their pre-earthquake condition. The branch shop in Shibaura was unaffected by the disaster, and on March 31, 1924, was equipped with 57 various machine tools and 10 electric motors of 210 h.p. each. The Mita shop has 21 machine tools and 2 motors of 22 h.p. each. The clothing factory, where uniforms are made for the employees of the Bureau at cost, and the printing shop are in full operation with the most up-to-date machinery.



The Electric Bureau owns 237,346 *tsubo* of land, including right of way, and 54 buildings. The land is valued at Y.5,721,923.18, but no valuation is placed on the buildings in the latest report. Besides this, 20,444 *tsubo* of land and 26 buildings are rented for the use of the tram section.

The old-fashioned four-wheel cars are being replaced by 82 passenger bogie cars. There are many routes on which only small cars can be operated, so some new four-wheelers have been added to the Bureau's equipment.

At the end of the 1923-24 fiscal year the rolling stock was as follows :

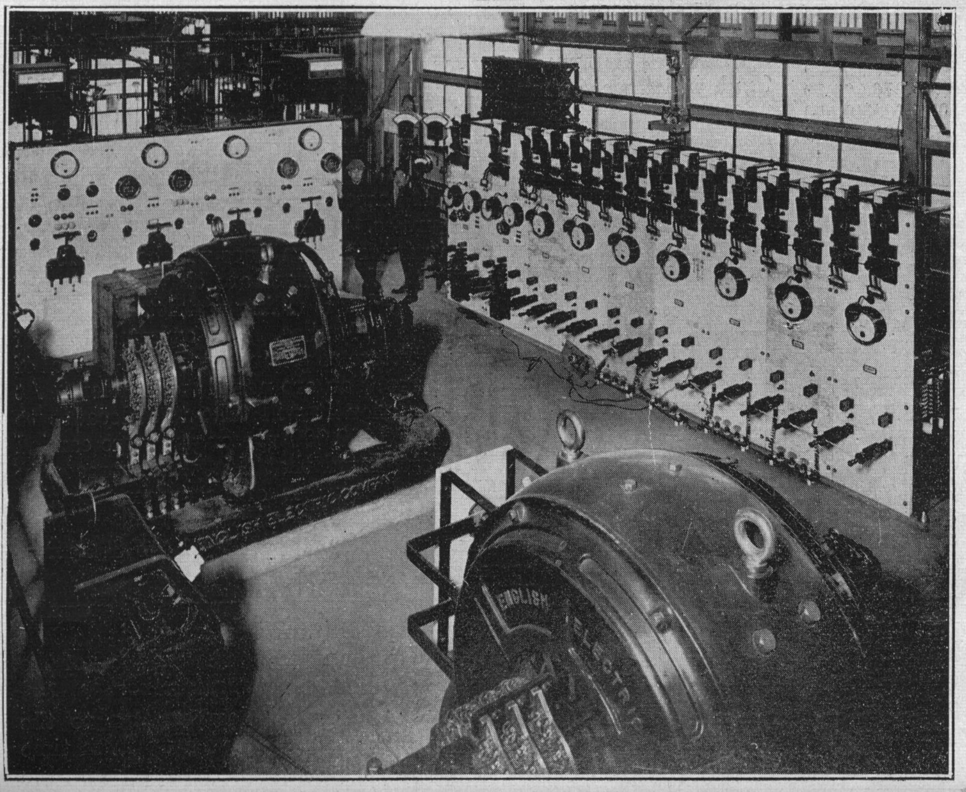
424	40-passenger	4-wheel cars
323	66 „	bogie „
97	76 „	„ „
458	82 „	„ „

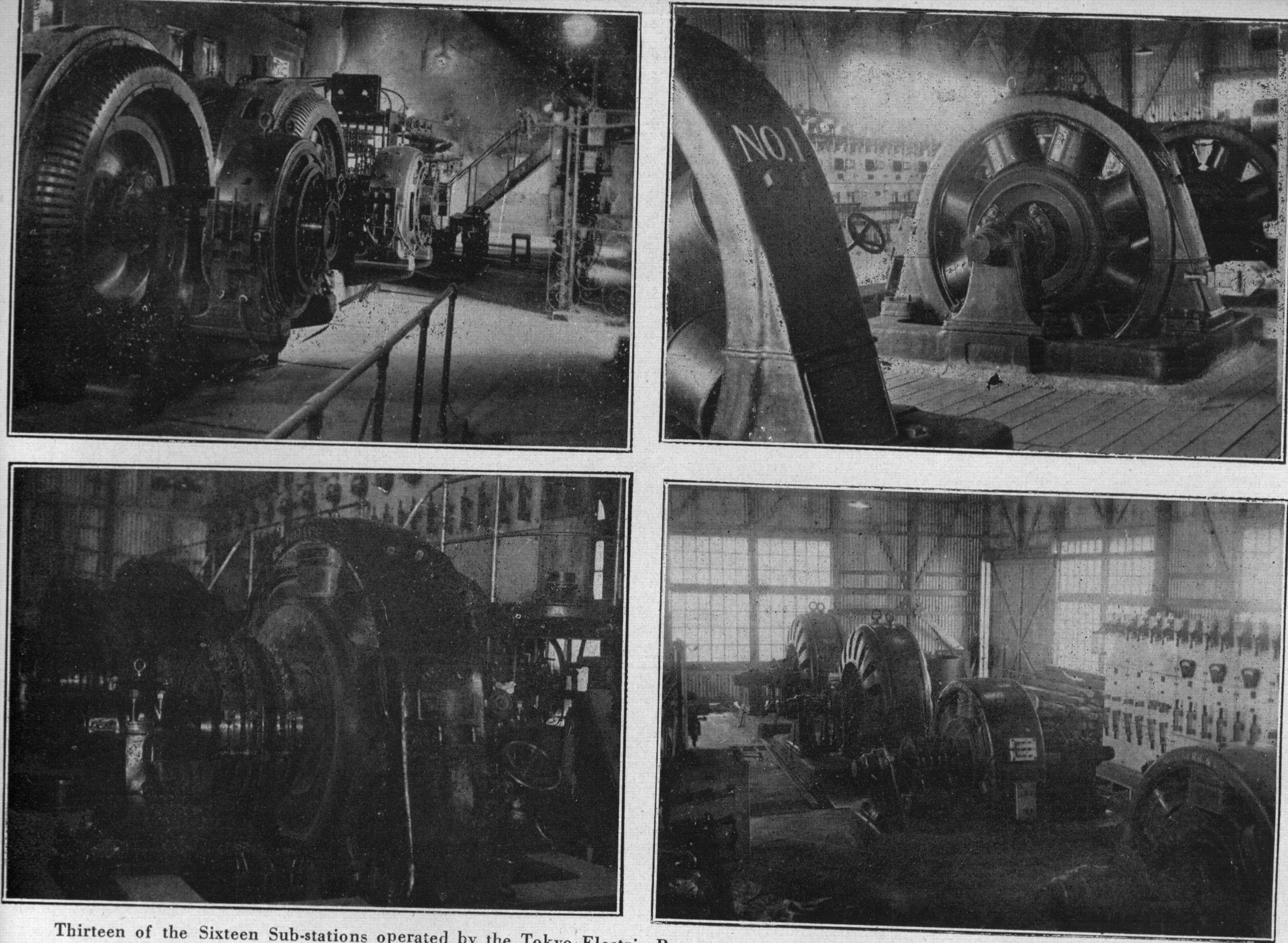
Total 1,380 passenger cars. In addition there are 62 five-ton freight cars.

From April, 1, 1923, to March 31, 1924, 59,191,243 k.w.h. of power was used in operating the tramways, an average of 1,253 k.w.h. per car per mile ; 2,371,981 k.w.h. was used for lighting the tracks, offices and works, making the total power used by the tramways 61,893,031 k.w.h.

The number of passengers carried during the year was 450,542,846, with revenues of Y.24,635,141.53. The number carried in March 1924 was the greatest for the year, but the fares collected did not approach the highest paid before the earthquake. During the earthquake month only 9,535,965 passengers were carried, but in December 1923 the number of passengers had again reached the monthly average before the disaster. The average number of miles run per month was 4,021,468.

The original purchase of the tramways and their subsequent extensions have been financed





Thirteen of the Sixteen Sub-stations operated by the Tokyo Electric Bureau were destroyed by the Earthquake and Fire. The above Illustrations are typical of the Temporary Stations erected to meet the emergency

Class of Bond.	Face Value Issue	Amount redeemed up to March 31, 1923	Amount redeemed April 1, 1923 to March 31, 1924.	Unredeemed March 31, 1924.
Electric Industry Deb. :				
A. English Issue ...	£5,175,000	£650,700	£84,000	£4,440,300
				Y.43,276,020.30
B. French Issue ...	F.100,880,000	F.8,981,500	F.1,458,000	F.90,440,500
				Y.34,881,304.23
Second Issue				
Electric Industry Debentures :				
"i"	Y.10,000,000	Y.968,700	Y.309,000	Y.8,822,300
"ro"	5,000,000	40,000	49,300	4,910,700
Electric Industry :				
Short Term Loan Bonds	Y.10,000,000	—	—	Y.10,000,000
Second Issue ...	15,000,000	—	—	15,000,000
Third Issue... ...	20,000,000	—	—	20,000,000
Fourth Issue ...	20,000,000	—	—	20,000,000

The total amount unredeemed on March 31, 1924, was Y.156,-890,324.53, of which Y.78,733,000 was in domestic and Y.78,157,-324.53 in foreign issues.

After the earthquake the Municipality was induced by the Chief of the Electric Bureau to start a motor bus service as an auxiliary to the surface lines. An order for 1,000 Ford chassis was given to Sale & Frazar, and these fitted with a rough passenger bus body, but the service has not proved a success. After a year most of the old Ford buses were superseded with new ones equipped with proper passenger bodies. These have proved popular, and the service is now being expanded and extended. By January 1924 135 buses were in service; in February 274; and by the end of March the number had increased to 800. These buses were 5-ft. 5¾-in. wide, 15-ft. ½-in. long, and 7-ft. 5⅛-in. high. The city also owns 40 motor cars for other service.

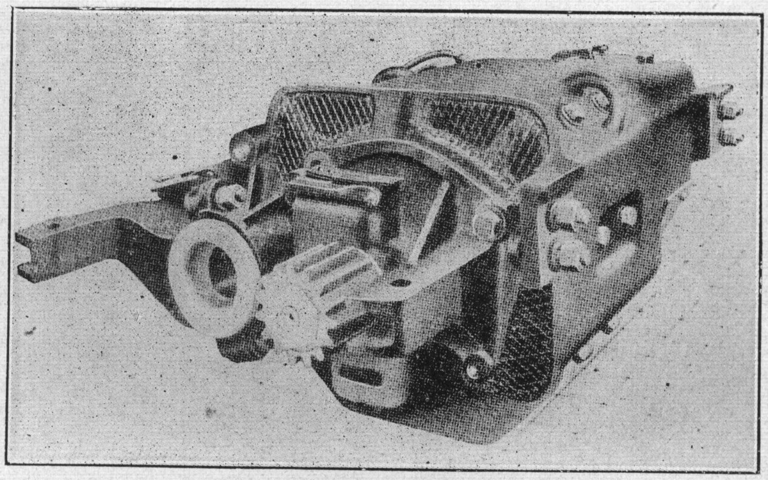
The Bureau's income from tramway operation in 1923-1924 was Y.26,299,438.075, with expenditures of Y.18,277,268.87, leaving a profit of Y.7,982,169.205. This was insufficient to pay the fixed interest charges, annual deposits to legal reserves, and payments into the general account of the Municipality, by Y.2,002,-300.255. This sum, however, was paid out of the special reserve fund, which was exhausted by the payment.

The future extension of the surface tramways of Tokyo is now linked with the Rapid Transit Program of the Municipality.

At the present time the surface trams on 180 odd miles of track carry the same number of passengers per mile as New York's rapid transit system of 600 miles. It has been decided by the Reconstruction Bureau that in future tram lines will be prohibited on roads less than 72-ft. wide, and as there are only 150 miles of 72-ft. wide streets in Tokyo to-day, this ruling restricts the future extension of surface tramways to 300 miles. The extreme limit of extension of the surface lines in Tokyo as planned provides a total of 372 track miles, or 182 miles more than are now in operation. At the present rate of new construction it will take two decades to arrive at this limit. In 1924, 480,000,000 passengers were carried on the surface lines and it is estimated that this will increase to 530,000,000 in 1925. The actual number of passengers carried per track mile should not exceed 700,000 a year, as in London, Paris and Berlin, limiting the transportation capacity of the 372 miles to about 600,000,000 passengers.

It is estimated that the number of passengers carried annually will reach 980,000,000 in 1937, and in another ten years (1947) to a total of 1,500,000,000, or more than double the capacity of the surface tramlines as limited by the new street regulations.

This traffic problem has naturally caused deep concern to the Electric Bureau, and many plans have been drawn up from time to time in order to find some practical solution. To supplement the



MITSUBISHI TRACTION MOTOR
1,500-50 H.P. Traction motors manufactured by The Mitsubishi Electrical Engineering Company, Ltd., at their Kobe and Nagasaki Works were Supplied to the Tokyo Municipal Electric Bureau Immediately After the Earthquake, Permitting the Early Restoration of Traffic.

transportation capacity of the surface lines four private, companies were licensed in 1919 and 1920 to construct underground railways serving the most important traffic routes in the city. This, it was hoped, would attract the long haul traffic, and leave the short haul for the trams. Financial difficulties, however, prevented three of these companies from carrying out their franchises, and their rights reverted to the city. One company, the Tokyo Underground Railway Company, began construction of the first section of its line on May 1, 1925. Convinced that little help was to be expected from private enterprise, the authorities have completed plans for the construction of about 50 miles of rapid transit lines to be built by the city, and operated by the Electric Bureau. These plans have been approved by the Municipal Assembly and the Government departments concerned and the budget estimates are now awaiting approval.

Visitors to Tokyo who travel from Yokohama on the railway cannot fail to notice the large number of street-car trucks, frames and motors piled up in the yard of the Tokyo municipal railways repair shop at Hammatsu-cho. The shop itself was completely destroyed by the fire, and had to be entirely re-equipped, though the reinforced concrete buildings themselves stood the earthquake very well.

The number of destroyed cars (800) was over half of the total available for service before the earthquake, so that in re-establishing the service it was necessary to order a large number of new bodies, trucks and electrical equipment.

Some of the equipment, not too seriously damaged by the fire, has been repaired, so that many of the equipments supplied by the General Electric Co. (U.S.A.) and the Dick Kerr Works of the English Electric Co., or the Toyo Denki in Japan, are still running.

A new type of double truck car has now been standardized having a lower floor than the previous double truck cars used. For the present the railway authorities have decided to standardize on motors and control made by Japanese manufacturers, and orders placed since the earthquake have been to these firms. All of these new cars have been furnished with air brake equipment. It is understood that the railway will dispense with the use of single truck cars on the lines having heavy traffic as rapidly as new equipment can be provided. This will, in part, remedy the congestion of traffic in many parts of the city where the schedule speed of the cars has been rather low.

As well as being faced with the destruction of a large part of its rolling stock, the railway had to provide for sub-station equipment destroyed or seriously injured by the fire. One of the large down-town sub-stations at Yuraku-cho, containing General Electric rotary converters, was completely destroyed, but the rotaries themselves were of such sturdy construction that they passed through the fire and are now being rewound and reconditioned by a local electric works preparatory to being again placed in service. Likewise, the three 1,000 k.w. General Electric frequency changer units in the Kyobashi substation were located in a building destroyed by the fire, but after having field coils replaced and a few minor repairs made, they are now operating as usual.

The Railway was in a way fortunate in having placed orders some time prior to the earthquake for automatic substation equipment to be supplied by the Westinghouse Electric and Manufacturing Co. and by the General Electric Co., these equipments being automatic rotary converter sub-stations. The Brown-Boveri Co. have supplied some mercury arc rectifiers. This equipment has since been installed and is now operating supplying power to the Railway's 600- volt trolley system.

The Tokyo Municipal Electric Bureau, of which the Tokyo Municipal railways is a part, receives its power from private hydro-electric companies which during the dry season are not always able to maintain their output, so that the Railway is now calling for tenders on a 100,000 k.w. steam station to be located in the Shibaura district of Tokyo. It is understood that a decision will be made in regard to the equipment for this station and orders placed during the current year, so that construction may be started next year.

In view of the fact that its load is continuously increasing, the Municipal authorities have recently acquired the water rights owned by the Kanto Dento, and are now studying how the available power may best be developed and brought to Tokyo by high tension transmission lines.

The English Electric Co., Ltd. assisted to no small extent in restoring the tramway damages by placing their organization at the disposal of the Municipal authorities, and in response to urgent telegraphic instructions many hundreds of their D.B. 1 Form K tramway controllers and type "A" 1 circuit breakers were manufactured and shipped to Tokyo in a remarkably short space of time. The products of this company were the first to be installed in the city of Tokyo over 22 years ago.

The question of replacing sub-station machinery was not so easy, such apparatus requiring a considerably longer period to manufacture. With 13 substations either totally or partially destroyed it was necessary for the Municipal engineering department to apply for assistance to industrial areas of Japan unaffected by the catastrophe. Fortunately, the Keihan Electric Railway Co. of Osaka, also equipped with Dick Kerr apparatus, immediately shipped to Tokyo such rotary converters. transformers and switchgear as could be

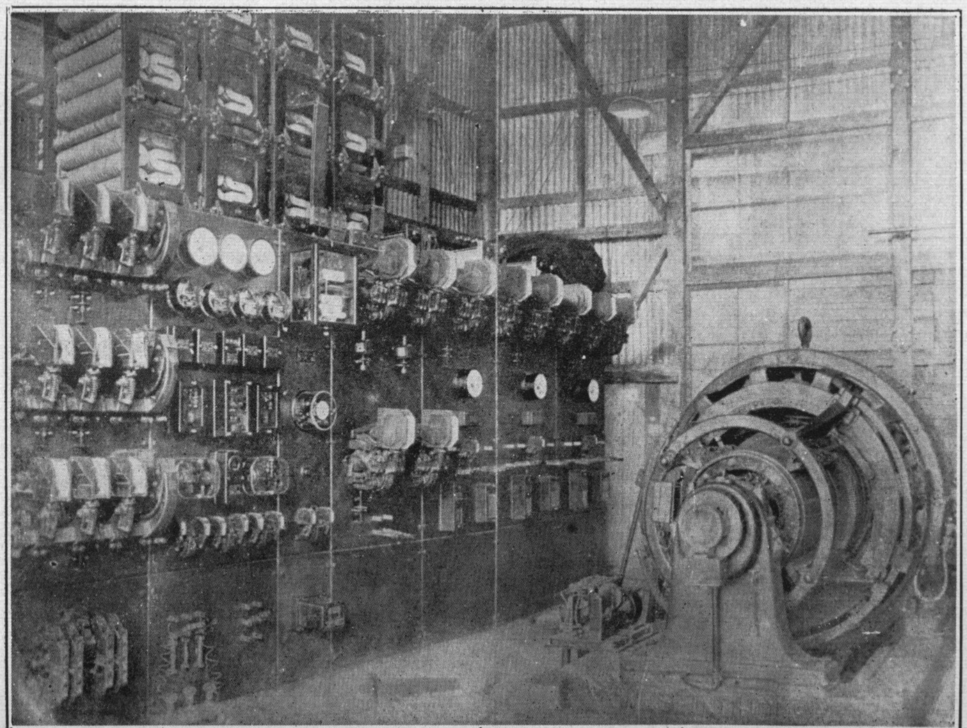
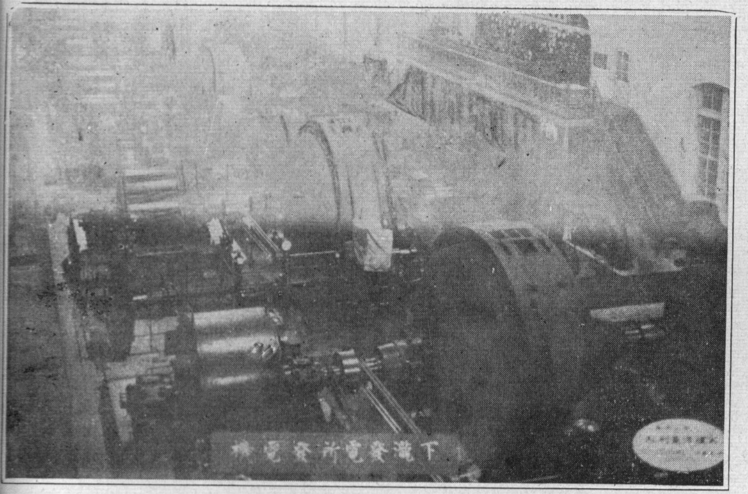
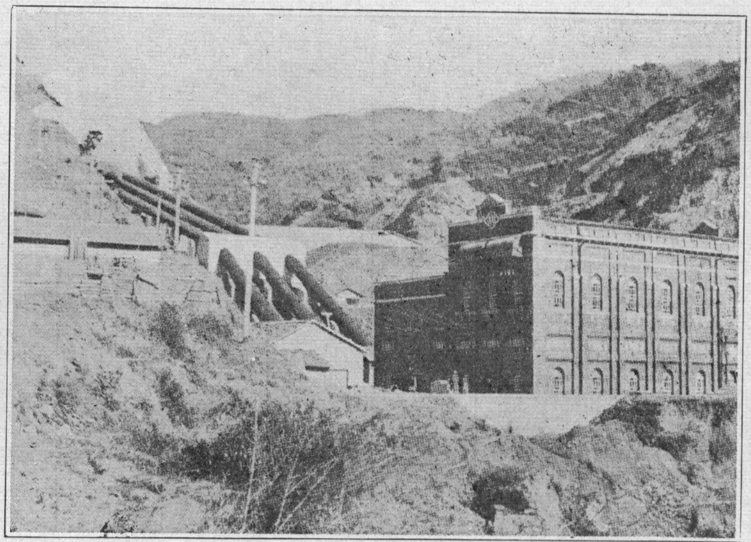


Fig. 1—Westinghouse Automatic Sub-station for the control of a 1000 k.w., 600 Volt d.c., Synchronous Converter Sub-station for the Tokyo Municipal Electric Bureau, Tokyo, Japan

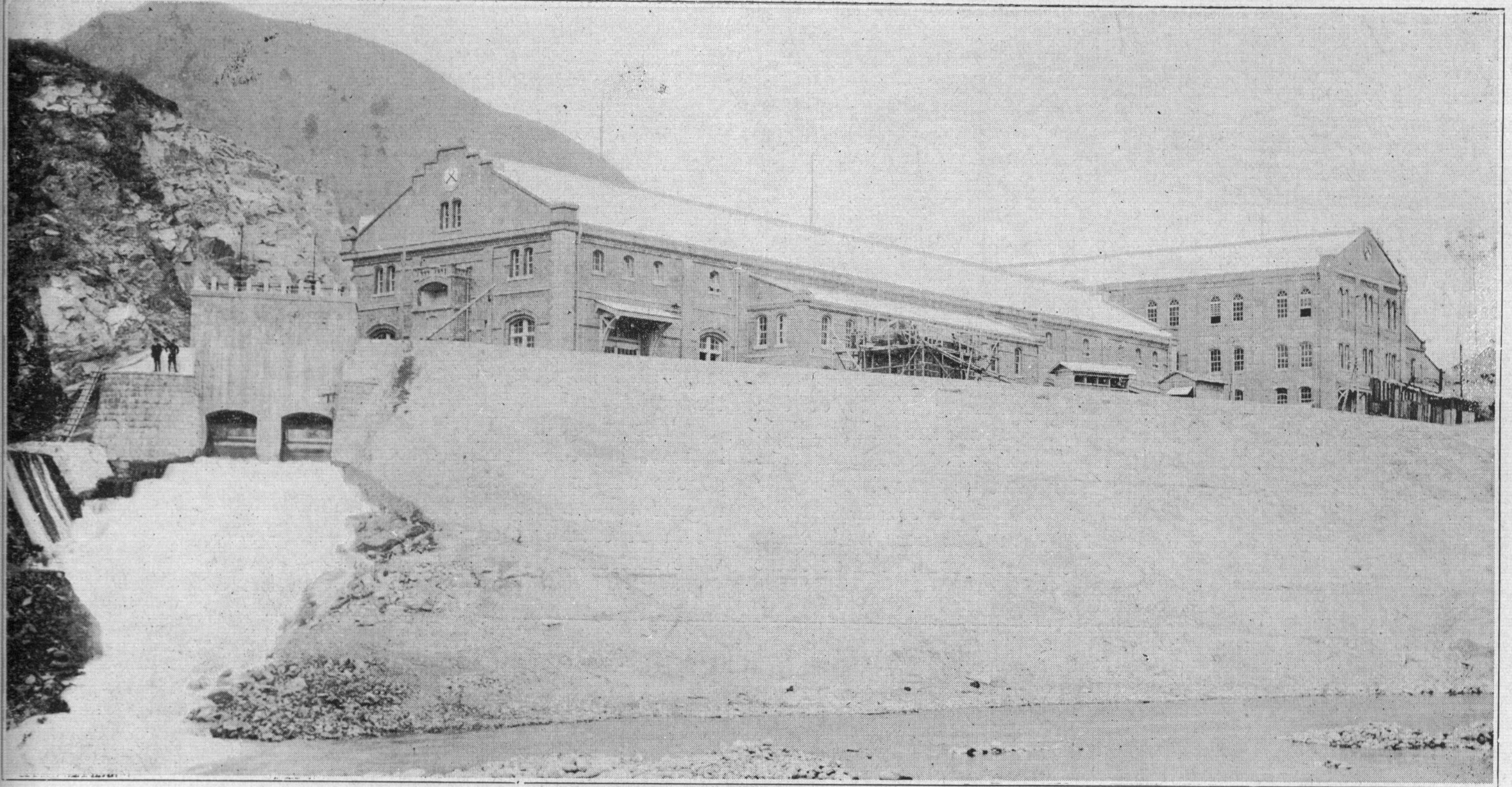
Tokyo's Tramways are Operated by Power Purchased from the Kinugawa Hydro-Electric Company



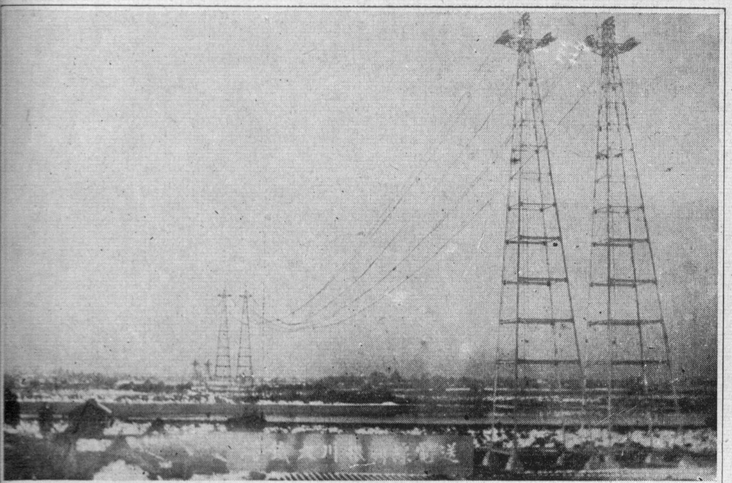
Interior of the Shinotake Power House of the Kinugawa Hydro-Electric Company



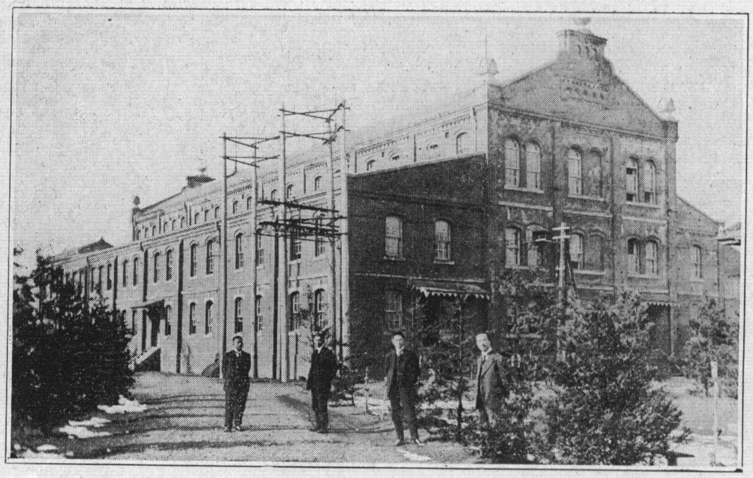
Wakayama Suiryoku Denki Kaisha, No. 2 Power Station on the Hidaka-gawa



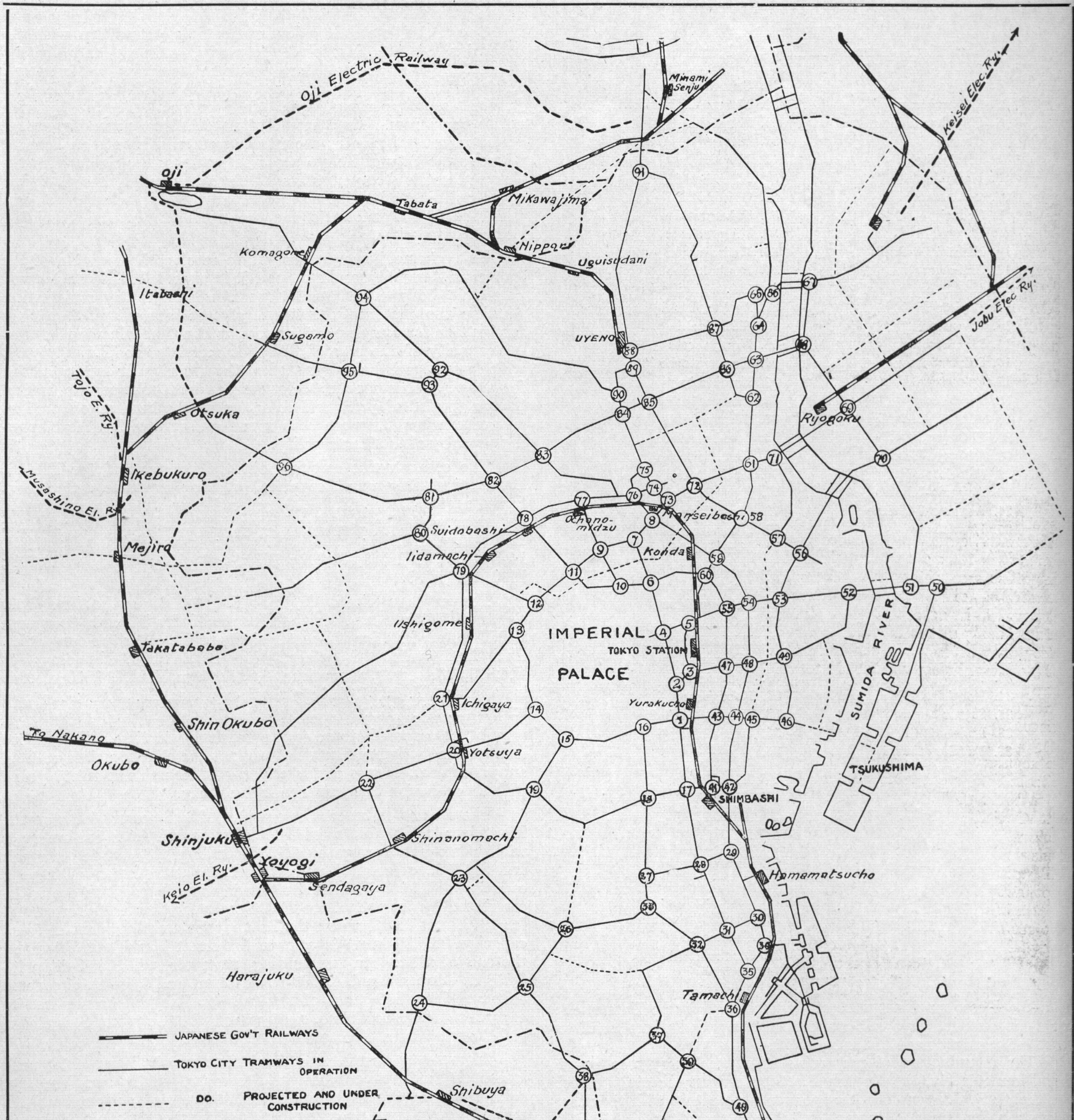
Power House of Kinugawa Hydro-Electric Company at Shinotake, Tochigi Prefecture



Transmission Tower of the Kinugawa Hydro-Electric Company Crossing the Tone River



Transformer Station near Tokyo of the Kinugawa Hydro-Electric Co.



THE MUNICIPAL TRAMWAY SYSTEM OF TOKYO

Nearly 1,400 passenger cars are operated over 200 track miles and 100 route miles of tramways by the Municipal Electric Bureau of Tokyo. The map shows the various tramway lines in relation to the Electrified Belt Line of the Japanese Government Railways and the Private Suburban Electric Tramways Feeding into the Urban System at the City Line.

The numbers on the map represent the principal street corners and tramway passenger exchange points throughout the city and correspond to the names given on the opposite page.

MAP OF TOKYO MUNICIPAL TRAMWAY

Street Junctions Corresponding to Numbers on Map

1. Hibiya
2. Babasakimon
3. Shiyakusho-Mae
4. Otemachi
5. Eirakucho
6. Kandabashi
7. Ogawamachi
8. Sudacho
9. Surugadai
10. Nishikicho-Gashi
11. Jinbocho
12. Kudan-Shita
13. Kudan-Ue
14. Hanzomon
15. Miyakezaka
16. Sakuradamon
17. Sakurada-Hongocho
18. Toranomon
19. Akasaka-Mitsuke
20. Yotsuyamitsuke
21. Ichigaya-Mitsuke
22. Shiocho
23. Aoyama-Ichome
24. Aoyama-6-Chome
25. Kasumicho
26. Roppongi
27. Kamiyacho
28. Onarimon
29. Utagawacho
30. Kanasugibashi
31. Shibazonobashi
32. Akabanebashi
33. Iigura
34. Honshiba
35. Satsumahara
36. Fudanotsuji
37. Furukawabashi
38. Tengenji
39. Gyoran-Sakashita
40. Sengakuji-Mae
41. Dobashi
42. Shibaguchi
43. Sukiyabashi
44. Ginza
45. Miharabashi
46. Honganji-Mae
47. Kajibashi
48. Kyobashi
49. Sakurabashi
50. Monzen-Nakamachi
51. Kuroecho
52. Eitai
53. Kayabacho
54. Nihonbashi
55. Gofukubashi
56. Suitengu-Mae
57. Ningyocho
58. Kodenmacho
59. Honkokucho
60. Shintokiwabashi
61. Asakusabashi
62. Katamachi
63. Umayabashi
64. Komagatacho
65. Kaminarimon
66. Adzumabashi
67. Adzumabashi
68. Sotodemachi
69. Kamezawacho
70. Morishitacho
71. Ryogokubashi
72. Idzumibashi
73. Manseibashi
74. Manseibashi
75. Hatagocho
76. Matsuzumicho
77. Ochanomidzu
78. Suidobashi
79. Iidabashi
80. Omagari
81. Denzuin-Mae
82. Kasugacho
83. Hongo-Sanchome
84. Ueno-Hirokoji
85. ——
86. Misujicho
87. Kikuyabashi
88. Kurumazakacho
89. Ueno-Hirokoji
90. Ueno-Mihashi
91. Minowa
92. Hongo-Sakanamachi
93. Hakusan-Ue
94. Kamifujimaemachi
95. Kagomachi
96. Otsukamachi

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spared. These machines were quickly installed in the Yuraku-cho, Oshi-cho and Ichigaya sub-stations, and supplied to no small extent the pressing need of the moment.

The manufacture of new sub-station machinery was put in hand immediately, the English Electric Company receiving orders for their "R. J." type of rotary converters together with the necessary transformers and control switchgear apparatus.

The typical illustration of the temporary "barrack" substation located in the well-known Nihonbashi quarter of Tokyo is shown in the accompanying illustration. In this station the high tension supply of 6,600 volts 3 phase 25 cycles is stepped down through single phase transformers. The rotary converters are two "R.J." type 4 pole 25 cycle high speed machines fitted with roller bearings giving a continuous output of 1,000 k.w. at 600 volts.

The Shinagawa sub-station of the Keihin Electric Railway Company temporarily supplying tramway power to the Tokyo Municipality is also illustrated. The installation consists of two "R. J." type, high speed rotary converters of 500 k.w. capacity, running at a synchronous speed of 1,500 r.p.m. In this case the high tension supply is 3,300 volt, 50 cycles, and stepped down through 3 phase transformers. The machines are also fitted with roller bearings.

Electric Bureau's New Power Scheme

One of the interesting developments in connection with the expansion of the Municipal tramway, subway and lighting system is the project for acquiring sufficient water power rights and generating stations as will make the Municipal Electric Bureau self-supporting and independent of the private power companies. As a result of negotiations extending over a period of several months a contract was entered into on June 19 whereby the City of Tokyo acquired water-power rights from the Tokyo Electric Company, the Kwanto Hydro-Electric Company and the Tokyo Electric Power Company, which, when developed, will give 90,000 kilowatts for the operation of the Municipal electric enterprises.

This scheme, however, has yet to receive the sanction of the Municipal Assembly, and although it is expected that the bill will pass this body with certain modifications it is problematical whether the present Cabinet will give its consent to floating a foreign loan for carrying out the scheme at a time when the borrowing capacity of the city of Tokyo is restricted to Y.100,000,000, which privilege is being guarded as the security for issuing a loan for subway construction. However, as both schemes are spread over a period of years and come under the heading of productive enterprises, they are both sound and well within the borrowing capacity of the Municipality.

The estimate for carrying out the program of the Electric Bureau, including purchase price, working expenses and reserve funds, aggregates Y. 63,050,000, spread over an eight-year period beginning with the 1925 fiscal year, in the following proportions: 1925, Y. 7,390,000; 1926, 9,870,000; 1927, 11,300,000; 1928, 14,480,000; 1929, 5,760,000; 1930, 4,410,000; 1931, 6,980,000; 1932, 2,960,000.

The purchase price is placed at Y. 5,834,000 for the three water rights, Y. 100 per k.w. for the Kwanto Hydro Electric Company, and Y. 20 per k.w. for the water rights of the other two companies. The land value is placed at Y.1,537,000, buildings at Y.3,896,000; canals, reservoirs and waterways, Y. 24,635,000; electric installation, Y. 22,873,000; general expenses, Y. 2,260,000; and reserve Y. 2,112,620.

It is proposed to raise the funds by issuing a Tokyo city loan on the foreign market that will net the city 86 points with an annual interest charge of six per cent. redeemable in thirty years, with amortization to commence in five years.

The scheme embraces the erection of two power plants on the Tone river in the vicinity of Shibukawa served from one reservoir with open canals aggregating 3,118-ft. in length, 30,000-ft. of tunnels and 3,900-ft. of covered culverts. These two plants will have a capacity of 45,000 k.w., and according to the program are to be completed by the end of the 1929 fiscal year and ready for service for 1930. At Karabori on the Azumagawa another plant of equal capacity (27,500 k.w.) is also to be erected and completed by the end of 1932. An impounding reservoir will be built with 3,150-ft. of open canal, 42,000-ft. of tunnel and 3,540-ft. of covered culvert. Over 100 miles of transmission line will be required to carry the current to Tokyo, eighty miles from Tokyo to Shibukawa, and 20 miles from Yatsumata to Karabori.

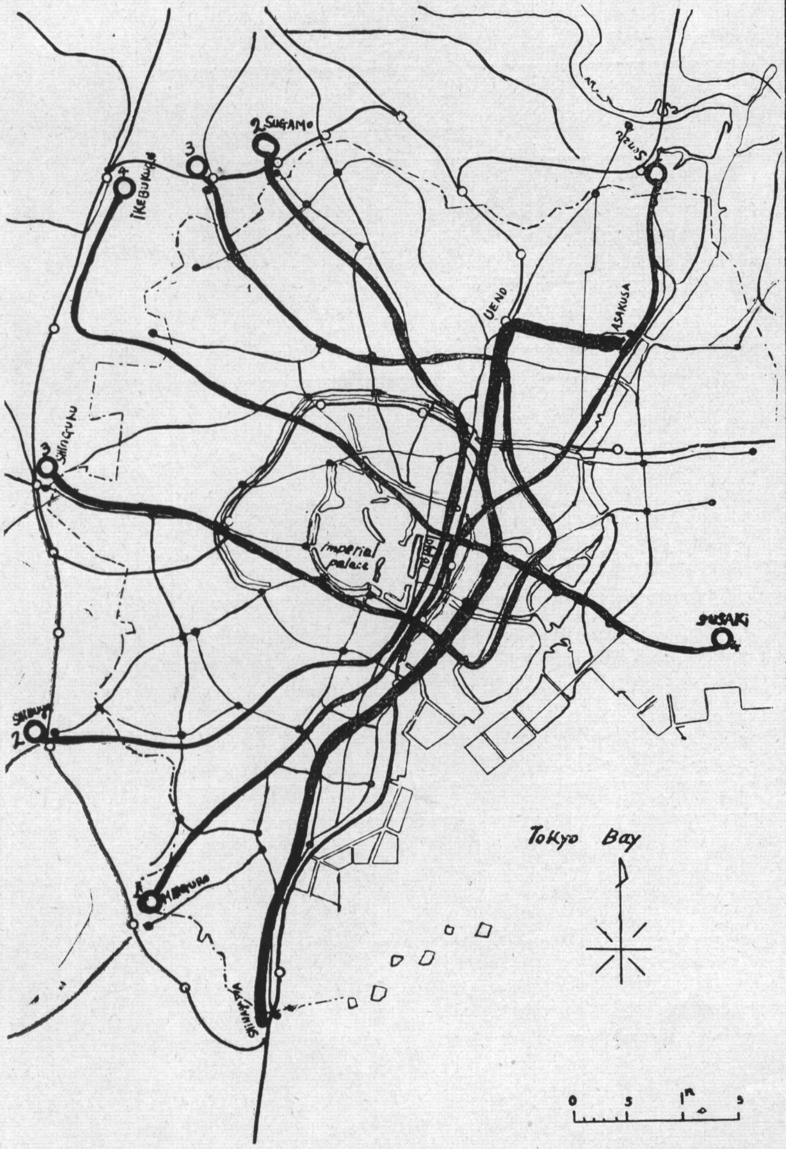
In order to guarantee a continuous supply of power, at peak load during the low-water season (December, January and February) a large steam generating station will be erected at the site of the present power-house operated by the Electric Bureau at Shibaura in Tokyo. This part of the program is to be completed by the end of 1926.

The Electric Bureau of the Tokyo Municipal Government now purchases some 45,000 kilowatts from the Tokyo Electric Light Company, the Kinugawa Hydro-Electric Company and the Tokyo Electric Power Company at a uniform rate of .025 sen per kilowatt. Under the new self-supporting scheme it is estimated that the city can supply its own power at a cost of .0203 sen per kilowatt during the period the loans remain unredeemed, and after their redemption the cost will be reduced to .008 or .009 sen per kilowatt. Under this scheme, by the end of 1932 the city would be able to provide 72,800 kilowatts from its own power plants and supply current to the subway lines then open for traffic. At the cost price per unit the Electric Bureau would become self-supporting from the revenue of its own enterprises.

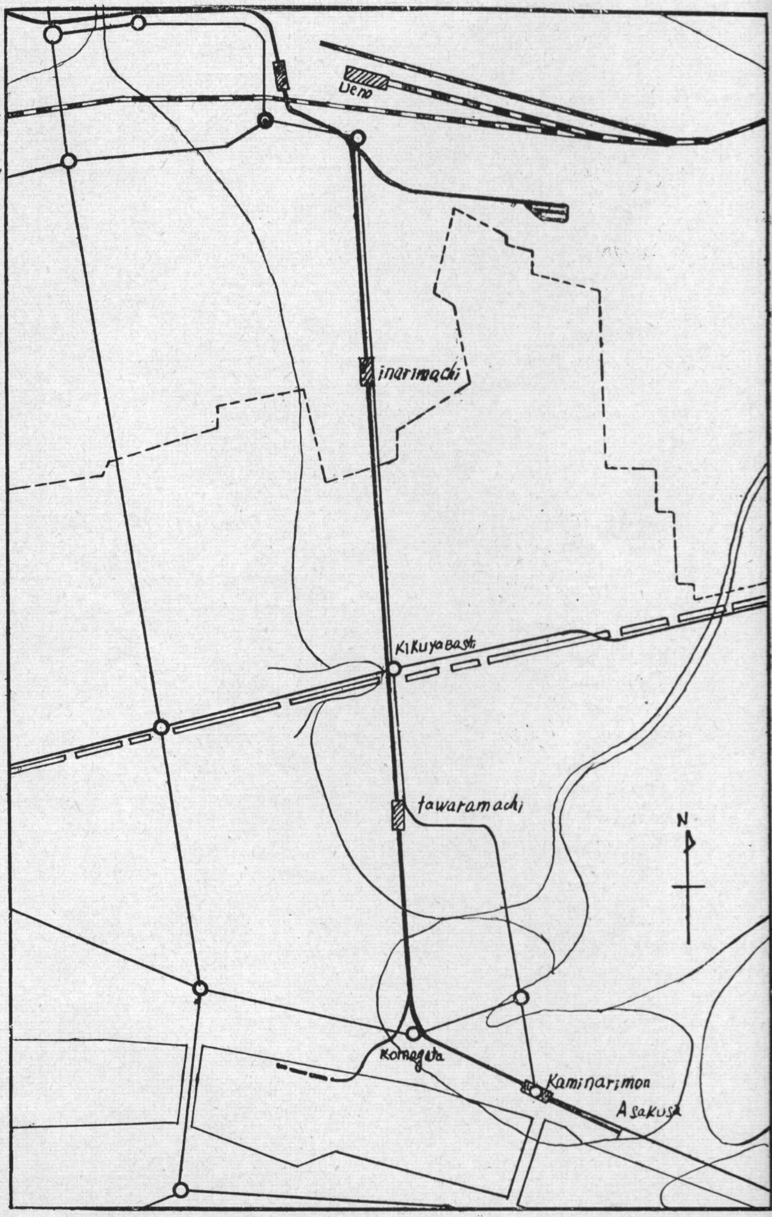
Breaking Ground for Tokyo's New Subway

Okura Engineering Company Starts Work on First Section of the Tokyo Underground Railway between Uyeno and Asakusa Park

THE first step in the construction of an adequate underground transportation system for the rapidly growing city of Tokyo was taken on May 1, when the Okura Engineering Company, Ltd., started work on the first section of the line held under charter from the city government by the Tokyo Underground Railway Company, Ltd. This company is one of four private concerns which obtained franchises during the boom days of the war to construct and operate subway lines in the city of Tokyo. The other three, failing to obtain the necessary capital to commence work within the time limit specified in their charters, automatically forfeited their rights and it began to look as though the franchise of the Tokyo Underground Railway Company would suffer the same fate. The continued depression in the home money market prohibited a further call on the shareholders and destroyed any possibility of issuing debentures. The future of the company was very gloomy, when in December last, the Okura interests agreed to furnish the capital necessary to construct the first section and save the franchise from lapsing by starting work before the expiry of the time limit. The section selected for immediate construction is the one between Uyeno station extending eastwards for one and a half miles to the Azuma Bridge and terminating near the entrance to Asakusa Park, the playground of Tokyo's millions. The estimated cost of this initial section, (Y.6,000,000), is being advanced by the Okura Engineering Company and as construction proceeds, the subway company will pay for completed work in promissory notes bearing interest at the rate of 9 per cent.



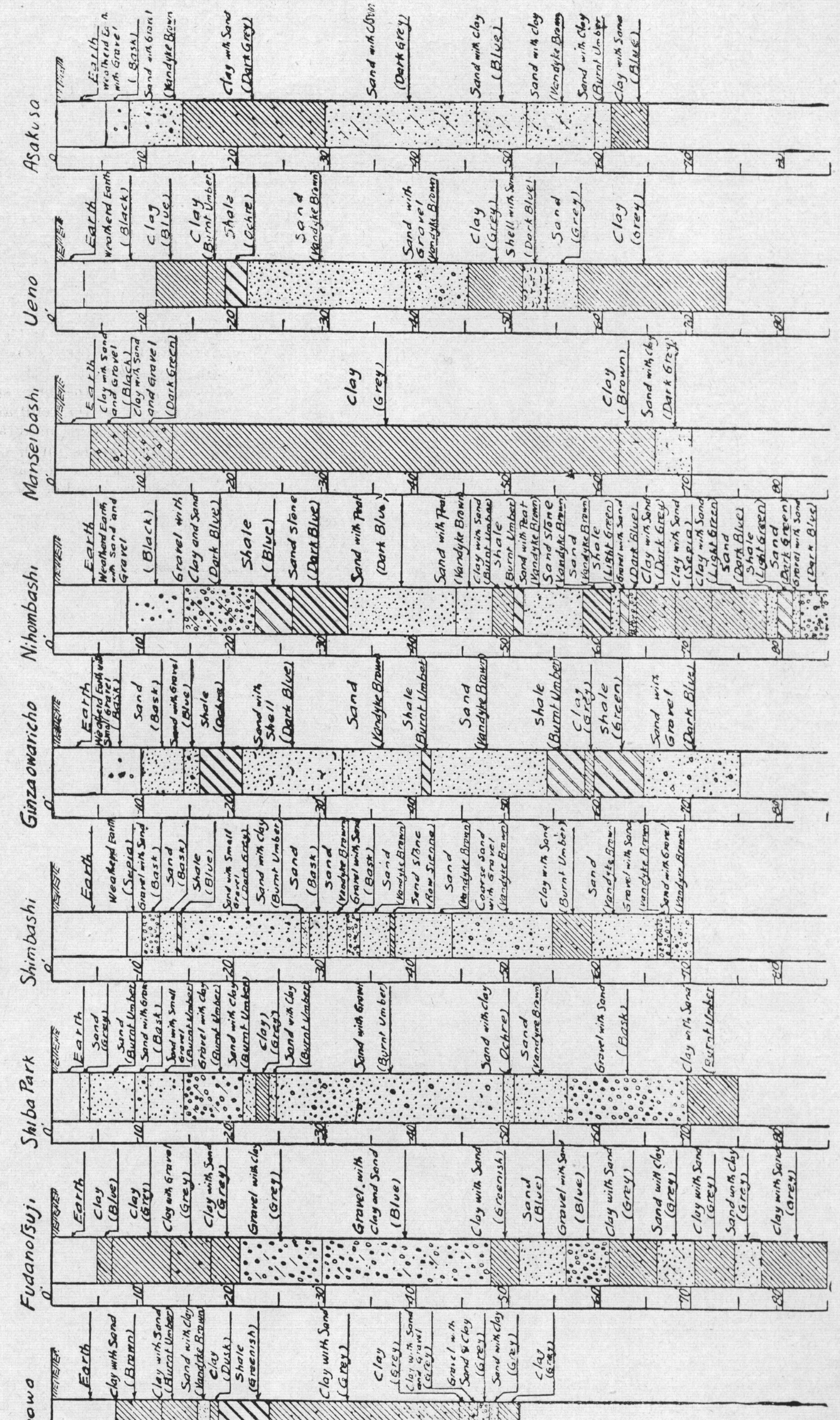
General Subway System of Tokyo : Showing Line of Tokyo Subway Co., Ltd.



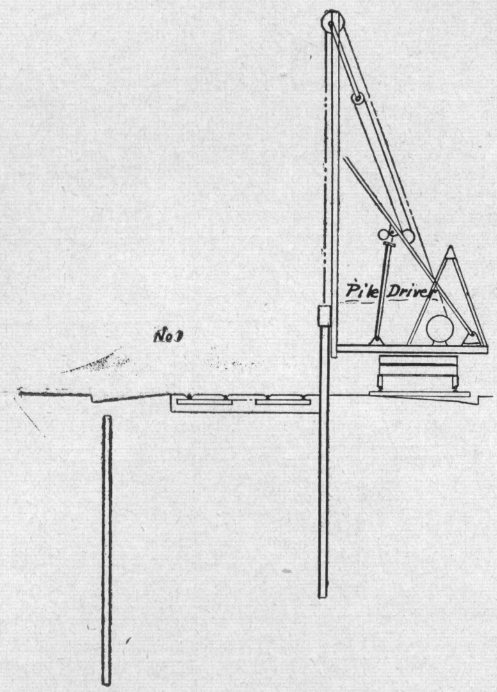
Section of Tokyo Subway between Uyeno and Asakusa on which Work has been Commenced

The franchise held by the Tokyo Underground Railway Company covers a line from Fudanotsuji to Asakusa passing through the very heart of the city, serving its most important business and shopping districts as well as its most popular parks and amusement centre. Undoubtedly, it will become the most profitable of all the transportation lines projected for the capital and for this reason the city authorities were anxious to include it in the general

RESULT OF BORINGS ALONG THE ROUTE OF THE TOKYO UNDERGROUND RAILWAY



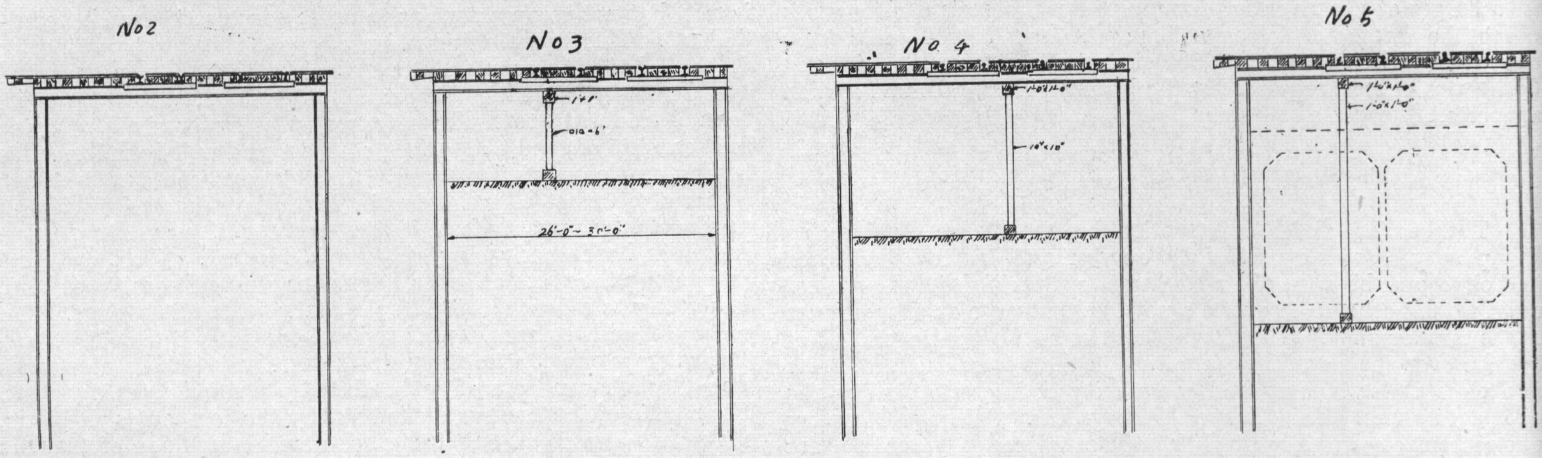
Nature of Soil along the Route of the Tokyo Subway Company's Line Between Shinagawa and Asakusa from Borings

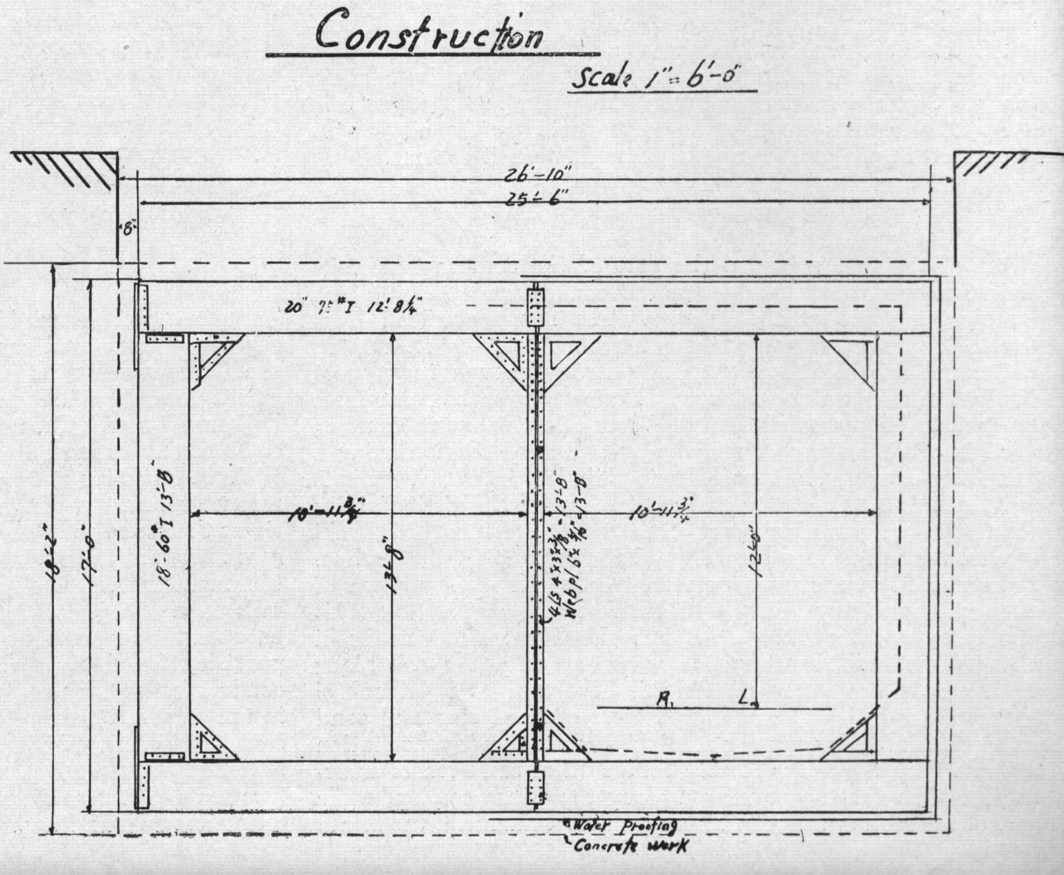


municipal rapid transit scheme. It is anticipated however, that as soon as the line is completed, negotiations will be started by the city government to purchase and operate it as part of the general municipal system.

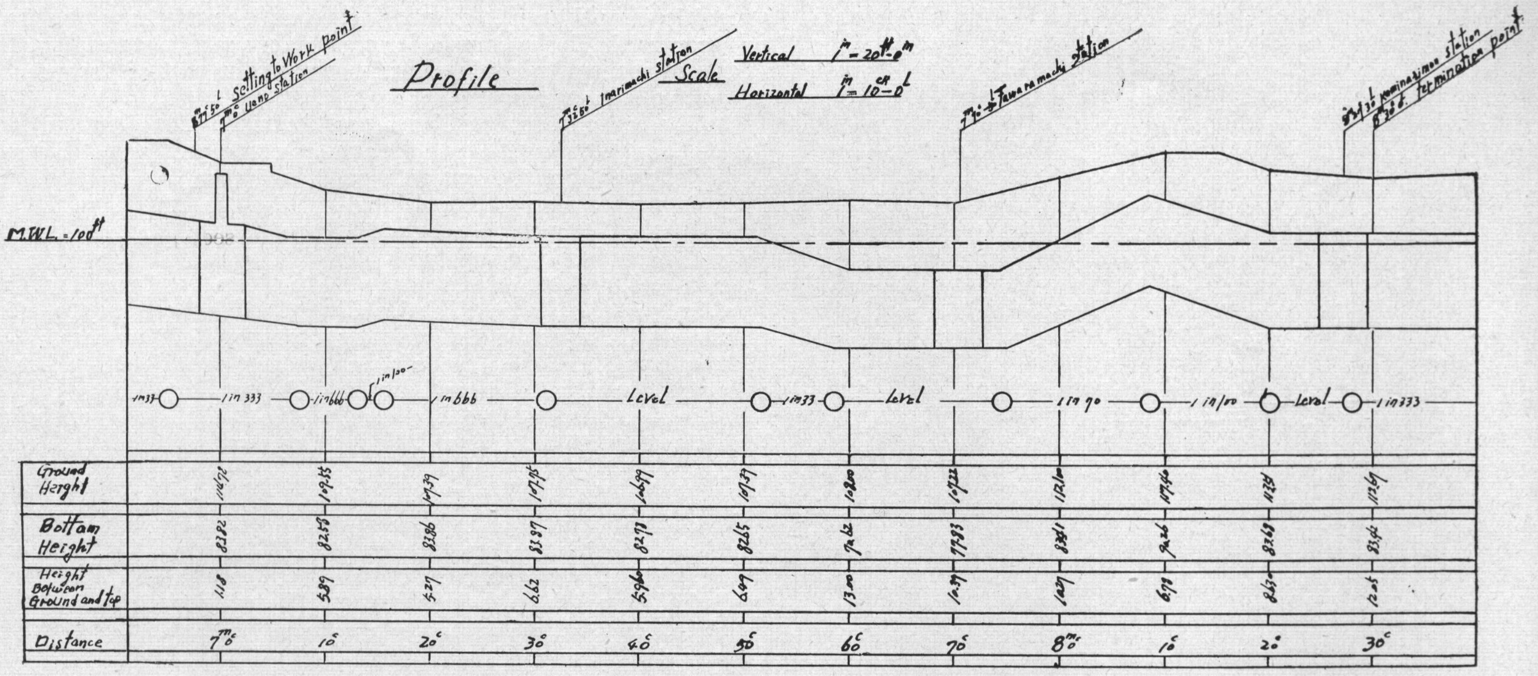
The section between Uyeno and Azumabashi will run underneath the streets on which surface cars are now operating, to Kikuya-bashi, Tawara-bashi, Komagata and along the Sumida River to the Azumabashi near Asakusa Park. With the exception of that part of the line along the Sumida River this section will be constructed on a hard sand strata which will carry a load of two tons per square foot. Water is reached at a depth of five feet throughout the section, so that along the Sumida River it will be necessary to build a water-tight retaining wall covering a total of 15,000 square *tsubo*. The excavation is to be carried to an average depth of 29-ft. below the street level, with a tunnel height of 19-ft. and top filling of 10-ft. Exclusive of the stations, the tunnel will be of the box-type, double track system, 27-ft. wide and built throughout of reinforced concrete.

The method of construction, following the general lines employed in building the Berlin subways, provides for uninterrupted surface traffic during construction. "H" beams, 12-in. by 5-in. will be driven on both sides of the line, spaced 33-ft. apart and rails laid across these to support the refill and carry the street and surface traffic. The streets are to be maintained as free as possible from obstructions and incumbrances during construction to facilitate which, a railway track will be laid along the surface over which the dirt cars will be hauled by gasoline locomotives and discharged





Plans Showing Method of Constructing the first section, (Uyeno-Asakusa), of the Tokyo Subway Company's Line, now being carried out by the Okura Engineering & Contracting Company, also section of Completed Subway



Profile of Uyeno-Asakusa Subway Section

into barges at the river for dumping into the reclamation works along the foreshore of Tokyo Bay. At least 30,000 cubic *tsubo* of earth will be excavated, 6,000 cubic *tsubo* of concrete laid and 6,000 tons of steel required for the beams, pillars, rails and station supports.

Only Private Subway Franchise

The section under construction by the Okura Engineering Company will form a part of the only private line to be operated in Tokyo and because of its strategic key position in the general rapid transit scheme, it exerts a powerful influence on the program of the municipality. The city authorities have made several offers to take over the franchise and although these were declined, there is a close understanding and community of interests binding the two enterprises. The Tokyo Underground Railway Company was organized in August 1920 to carry out a franchise for constructing and operating a subway line from Shinagawa on the south to Minami-Senju on the north, passing through Shimbashi, Sudacho, Uyeno and Asakusa, a total distance of 9 miles 40 chains. An understanding was subsequently arrived at in which the terminal sections between Shinagawa and Fudanotsuji, and Asakusa-Minami Senju were surrendered to the city to be incorporated in the greater municipal rapid transit scheme.

Soil Conditions

One of the first steps on the part of the company after its organization was to investigate the soil conditions of Tokyo along the projected route of the subway. The result obtained from nearly 200 borings, varying in depth from 50 to 100-ft. showed that the sub-soil of Tokyo was fully strong enough to support the weight of such an undertaking. Borings along the route from Shinagawa to Mita showed that for 70 to 80-ft. below the surface the soil is a hard strata of mixed clay and sand seams having a high loading capacity. From Mita to Shimbashi the soil consists of sand, pebbles, mixed clay and sand seams of sufficient rigidity to bear the weight of subway construction. From Shimbashi to Uyeno, the soil is very good, for 40 to 50-ft. below the surface, being composed in the main of sand seams and further down of pebbles and hard clay mixed with sand, stones and shale. This section is crossed by rivers at Shimbashi, Kyobasi, Nihonbashi and Manseibashi and contrary to the general rule, the soil along their banks is hard. At Shimbashi, Kyobashi and Nihonbasi it is exceptionally hard consisting mostly of hard clay and sand stone, most suitable for subway construction. From Uyeno station to Asakusa Park the soil is largely composed of sand seams somewhat finer than those encountered along the Ginza section, while in part of the section between Kikuabashi to Umamichi, the strata is soft, but not to an extent as to make construction work unduly difficult. This is the only section of the entire line requiring the driving of piles to obtain a proper foundation for the subway.

Generally speaking, almost all the ground along the route from Fudanotsuji to Asakusa (except the five or six feet of top soil) consists of sand and gravel, compact and well bound together having ample sustaining power. This stratum contains sandwich layers of compact clay varying in depth from one to six feet at depths of ten to twenty feet, while at forty to fifty feet deep, coarse gravel or hard sandy clay stratum is reached. There are local areas along the route however, where the stratum consists of hard, sandy clay to a depth of 100-ft. the limit of the test borings. The general clayish composition of the sub-soil is such that little surface water is expected to flow into the excavation and such as does seep through can be readily handled by a small pumping plant. The results of the surveys carried out by the company's engineers, show that almost all sub-soil encountered is hardpan of compact sandy clay or compact sand and gravel, both having great sustaining power and little water, easy of excavation by pick and shovel. The rivers encountered along the route can be tunnelled under very easily by means of coffer-dams, the nature of the soil being such that pneumatic shields are not necessary. In fact, the only places in Tokyo where such construction methods will be essential, are the sections in the municipal scheme that carry the lines under the Sumida River to Honjo and Fukagawa wards.

Tunnel Dimensions

The main section of the line from Shimbashi to Uyeno, traversing the business and shopping district of the city, will run under the Ginza, with stations at Shimbashi, Owaricho, Minima-Denmacho-Nihonbashi, Honkokucho, Kandayekai-Maye, Sudacho, Hirokoji and Uyeno. The average roof of the subway tunnel in streets of 36 meters or more in width is to be 4-ft. below the street level, while in narrower streets the average depth as determined by the reconstruction authorities, is to be 11-ft. When passing under rivers the roof of the tunnel will be 3-ft. below the river beds. The space between the roof of the subway and the ground on the widest thoroughfares will be filled in with earth supporting the tramway rails only. In streets less than 33 meters wide where the distance between the roof of the subway and the ground level is to be 11-ft. provision is made for carrying the se.vers, gas mains and part of the conduit for high tension electric wires. This arrangement is shown in the standard street plans appearing in the article on street construction in this number. It will be seen from this that the construction of the 27-ft. wide subway along the principal thoroughfare from Ginza to Uyeno (more than 90-ft. in width) will only affect about half the street obviating the heavy costs incidental

to constructing a subway without interfering with the many underground works which complicate similar construction in western cities.

The maximum gradient of the whole line is estimated at four percent. and the shortest radius of curve at 300-ft. Most of the radio of the curves will however be 500 to 1,000-ft. The original plans of the company called for a double track box-type reinforced concrete tunnel, 22-ft. in width and 12-ft. in height in accordance with the regulations drawn up by the Department of Railways. Certain modifications have since been made in these arbitrary dimensions and in the Uyeno-Akasuka section the tunnel height will be 19-ft. and 27-ft. wide. The gauge for the entire underground system will be standard. The cars are to be all steel of the bogie type, measuring 8-ft. in width and 35 to 50-ft. in length. A speed of 35 miles per hour will be maintained with stops of 30 seconds at ordinary stations and one minute at the principal stations, the trains to be equipped to develop high speed at starting. The average speed, inclusive of stops is estimated at about 20 miles, enabing a train to make the 8 mile run between Shinagawa and Asakusa Park (with some 18 stops) in 25 minutes. All the cars will be equipped with automatic brakes and the entire line with an automatic block signal system.

Cost of Construction

The cost of construction inclusive of all equipment, passenger stations, sub-stations, automatic safety devices etc., is estimated at Y.4,000,000 a mile of double track tunnel and line. In comparison with the costs of similar work in Europe and America, this is considered as a maximum figure which will be considerably scaled down in actual construction. The original estimated cost of the entire line before the two terminal sections were surrendered to the city is as follows:

Estimated Cost of Construction

(Length, 9 Miles, 40 Chains)

Items	Details	Magnitude or Quantity	Cost per unit	Cost	Total	Remarks
Survey and Supervising	...	...	...	...	Y. 400,000	
Ground	...	...	...	...	1,845,000	
	Station ground	200 *tsubo*	Y. 1,000	Y. 200,000		Station entrance and Exit.
	Electric substation ground	300 ,,	400	120,000		
	Car sheed and shop ground	3,200 ,,	200	640,000		
	Compensation for the use of underground	1,700 ,,	450	765,000		
	Miscellaneous compensation	...	...	120,000		
Tunnel-excavating	...	...	...	...	26,334,840	
	Portions for building stations	5,250 *feet*	790	4,147,500		
	Portions for laying lines	44,910 ,,	474	21,287,340		
	For disposal of buried objects	...	...	900,000		
Line-constructing	...	...	...	...	1,120,000	
	Rails	20 *miles*	40,000	800,000		
	Switches and frogs	40 *sets*	1,000	40,000		
	Signal devices	...	...	280,000		
Stations	...	21	70,000	1,470,000	1,470,000	
Rolling stocks	...	...	...	...	3,125,000	
	Motor cars	50 *cars*	45,000	2,250,000		
	Trailers	35 ,,	25,000	875,000		
Electric lines	...	...	...	...	1,289,500	
	Third rails	20 *miles*	33,500	670,000		
	Lighting	...	...	72,000		
	Feeders	9.5 *miles*	25,000	235,500		
	Transmission	10 ,,	30,000	300,000		
	Communication	...	...	10,000		
Electric sub-stations	...	...	...	...	350,000	
Apparatus	...	...	...	...	200,000	
Shop appliances	...	...	...	...	220,000	
Buildings	...	...	...	...	290,000	
	Electric sub-stations	240 *tsubo*	300	72,000		
	Car sheds	600 ,,	280	168,000		
	Shop buildings	200 ,,	250	50,000		
General expenses	...	...	...	...	500,000	
Total	...	...	...	...	37,144,340	
	Per mile	...	...	...	3,909,931	

(2) *Tsubo* is equal to about 36 square feet.

The above estimate is based on the par value of the yen and prices and wages prevailing in 1921, and therefore subject to the fluctuation of exchange and the prices of materials.

Revenues

In estimating the subway revenues it as assumed that it will attract one third of the number of passengers riding on the main line of the Tokyo Municipal Tramway running from Shimbashi to Akasuka along the Ginza and Sudacho, paralleling the proposed subway route. This assumption is based on the fact that the carrying capacity of the municipal tramway line is incapable of further expansion and therefore with its better facilities for handling the traffic, the subway will not only relieve the congestion but attract the surplus and all the long haul traffic.

The estimated number of passengers and receipts from fares for the first ten years is as follows:

Year	Rate of increase	Number of Passengers	Average fare	Receipts from fares
	%		Yen	Yen
1926		56,938,397	.120	6,832,608
1927	18	67,187,308	.120	8,062,477
1928	20	80,624,770	.120	9,674,972
1929	18	95,137,229	.120	11,416,467
1930	15	109,407,813	.120	13,128,938
1931	10	120,348,594	.120	14,441,831
1932	10	132,383,453	.120	15,886,014
1933	7	141,650,295	.120	16,998,035
1934	7	151,565,815	.120	18,187,898
1935	7	162,175,422	.120	19,461,051

The rather low rate of increase in traffic is based on the figures of the Tokyo Electric Tramways of 1921, which show an eight per cent. annual increase, but on the other hand the rate of increase for the Toyko high-speed electric suburban lines of the government railways, is from 22 to 40 per cent. annually. On the opening of the subway in Madrid (a city of 652,000 population) the number of passengers carried the second year was 14,627,466. The Tokyo Underground Railway Company's estimate of the number of passengers per mile is nearly ten per cent. less than the Madrid line with its extension of 2.4 miles. In Europe and America the number of passengers carried by the subways is 2½ to 14½ times greater than those carried by the surface lines, so even if the number of passengers carried by the Tokyo subway reaches the lowest proportion in Europe and America, it should realize a revenue amounting to Y. 17,000,000 and pay a dividend of 20 to 30 per cent. per annum. These comparisons are valuable in inviting attention to the rather modest estimates of traffic prepared by the Tokyo subway company for the purpose of interesting capital in the enterprise.

The fares are to be levied according to the distance travelled, with a maximum of twenty sen for long and a minimum of five

sen for short hauls, or an average of twelve sen per passenger. An additional source of revenue to be derived from the sale of advertising space on the station platforms and cars, is placed at the conservative figure of Y. 120,000. It is also intended to operate a night freight service and as the line traverses the commercial and industrial center of the city, considerable revenue is expected from this source. The company, however, has not included this anticipated revenue in its estimate of receipts.

Expenditures

The estimated expenditures over a period of ten years is calculated as follows :

The estimates have been carried down to the most minute detail and based on actual wages and salaries. In estimating charges for the purchase of electric power, the Municipal Electric Bureau puts the cuurrent used for one car-mile at 1.21 to 1.28 k.w.h. and the Government Railway Department puts it at 2.7 k.w.h. for the interurban electric service between Tokyo and Yokohama. The subway company puts it a 4 k.w.h. with the expenses as follows :

Details of Motive Power Expenses

Use for	Quantity of current sent from	Quantity of current received by sub-plants	Cost of current received	
	K.W.H.	*K.W.H.*	Yen	
Electric car ...	13,910,880	15,120,522	453,615.660	Car-operated mile, 3,477,720 per-car mile 4.0 K.W.H.
Lighting and motive power	824,506	916,118	27,483.540	Computed number of 16-C.P. light, 4,000
Electric Signaling ...	346,750	388,360	11,650.800	For 72 signal devices
Total	15,082,136	16,425,000	492,750.000	Quantity of current received per day at sub-plants, 4,500 K.W.H. (e. g. 3 sen per K.W.H.)

The estimated revenue and expenditure for the first ten years following the opening of the line to traffic is as follows :

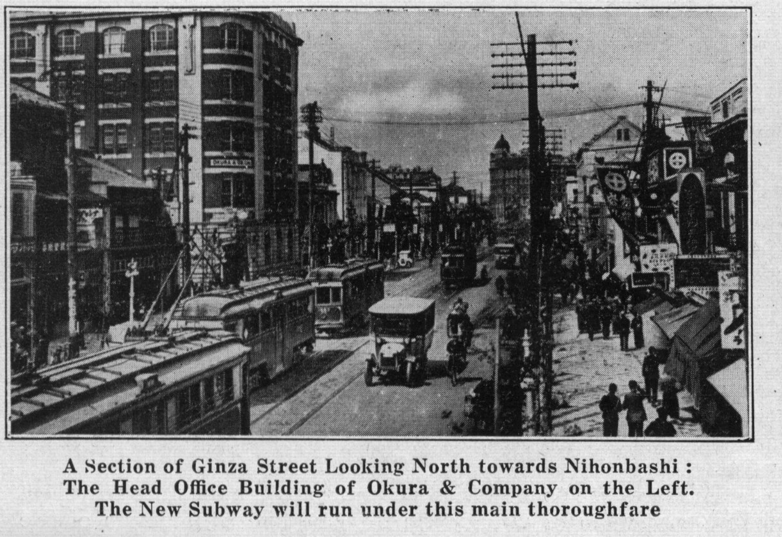
Year	Revenue: Passenger Fares	Revenue: From advertisements on station premises and the like sources	Revenue: Total	Expenditure	Net Profit	Percentage on Capital
	Yen	Yen	Yen	Yen	Yen	%
1926 ...	6,832,608	120,000	6,952,608	2,147,932	4,804,676	12.0
1927 ...	8,062,477	120,000	8,182,477	2,394,486	5,787,991	14.5
1928 ...	9,674,972	120,000	9,794,972	2,754,409	7,040,653	17.6
1929 ...	11,416,467	120,000	11,536,467	3,184,054	8,352,413	20.9
1930 ...	13,128,938	120,000	13,248,938	4,174,066	9,074,872	22.7
1931 ...	14,441,831	120,000	14,561,831	4,466,160	10,095,671	25.2
1932 ...	15,886,014	120,000	16,006,014	4,972,715	11,033,299	27.6
1933 ...	16,998,035	120,000	17,118,035	5,335,213	11,782,822	29.5
1934 ...	18,187,898	120,000	18,307,898	5,766,683	12,541,215	31.4
1935 ...	19,461,051	120,000	19,581,051	6,225,445	13,355,606	33.4

The future prospects of the company as set forth in the above estimate shows that at the end of five years the profit will be over 20 per cent. Comparison with the estimates for the construction of the Municipal Subway system and the normal rate of increase in the number of passengers that must be handled with the growth and expansion of the city, indicates that the figures given in this survey are most conservative. If we estimate that by the end of 1930, the total number of passengers that the Tokyo transportation system must be prepared to handle will exceed 700,000,000 and 900,000,000 by 1935, it would seem that the subway company is extremely modest in estimating that the key line of the new rapid transit system will carry 57,000,000 people the first year of operation.

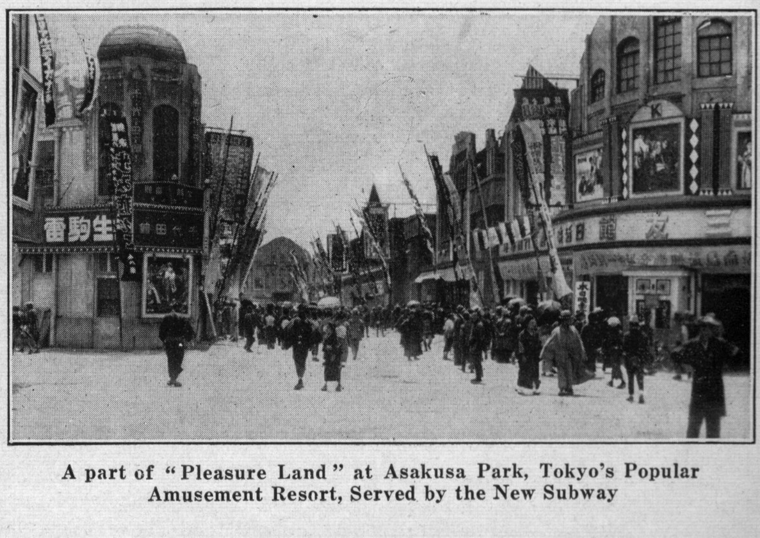
Estimated Expenditure for Ten Years Following the Opening of the Lines to Traffic

Year	Office Expenses: Percentage of increase	Office Expenses: Amount	Operating Cost: Percentage of increase	Operating Cost: Amount	Motive Power: Percentage of increase	Motive Power: Amount	Electric Sub-station Expenses: Percentage of increase	Electric Sub-station Expenses: Amount	Vehicles: Percentage of increase	Vehicles: Amount	Maintenance of way: Percentage of increase	Maintenance of way: Amount	Electric Lines: Percentage of increase	Electric Lines: Amount	Building Repairing: Percentage of increase	Building Repairing: Amount	Taxes: Percentage of increase	Taxes: Amount	Miscellaneous: Percentage of increase	Miscellaneous: Amount	Total
		Yen		Yen		Yen		Yen		Yen		Yen		Yen		Yen		Yen		Yen	Yen
1926 (first year)		193,000		818,724		492,750		18,100		77,250		41,800		15,880		15,000		325,428		150,000	2,147,932
1927	5	202,650	10	900,596	08	532,170	06	19,186	10	84,975	10	45,980	10	17,468	10	16,500	27	414,461	7	160,500	2,394,486
1928	5	212,783	12	1,008,668	10	585,387	06	20,337	12	95,172	11	51,038	10	19,215	10	18,150	28	571,924	7	171,735	2,754,409
1929	5	223,422	10	1,109,535	08	632,218	06	21,557	13	107,544	12	57,163	10	21,137	10	19,965	41	807,757	7	183,756	3,184,054
1930	5	234,593	07	1,187,202	06	670,151	06	22,850	15	123,676	12	64,023	10	23,251	10	21,962	102	1,631,577	6	194,781	4,174,066
1931	5	246,322	06	1,258,434	05	703,659	07	24,450	17	144,701	12	71,706	12	26,041	12	24,597	08	1,759,782	6	206,468	4,466,160
1932	5	258,638	06	1,333,940	05	738,842	07	26,162	19	172,194	13	81,028	12	29,166	12	27,549	19	2,086,340	6	218,856	4,972,715
1933	5	271,570	05	1,400,637	04	768,396	07	27,993	20	206,633	13	91,562	12	32,666	12	30,855	09	2,275,102	5	299,799	5,335,213
1934	5	285,149	05	1,470,669	04	799,132	07	29,953	21	250,026	15	105,296	12	36,586	13	34,866	10	2,513,717	5	241,289	5,766,683
1935	5	299,406	05	1,544,202	04	831,097	07	32,050	22	305,032	15	121,090	13	41,342	13	39,399	10	2,758,474	5	253,353	6,225,445

Note : The figures representing " Percentage of increase " indicate the rate of increase of expenditure of each year over the preceeding one.



A Section of Ginza Street Looking North towards Nihonbashi : The Head Office Building of Okura & Company on the Left. The New Subway will run under this main thoroughfare



A part of "Pleasure Land" at Asakusa Park, Tokyo's Popular Amusement Resort, Served by the New Subway

Tokyo's Municipal Subway Project

THE city of Tokyo is to have a double-track, standard guage subway system of five lines, four to be built by the Municipality and one private line by the Tokyo City Subway Company, Ltd. The four lines in the municipal scheme as finally approved by the City Assembly and the Railway Ministry, aggregating 41.56 miles in length, are estimated to cost Y.4,500,000 per mile, or a total of Y.187,020,000.

The funds for this purpose will be raised in a series of external loans ranging from Y.12,000,000 to Y.22,000,000, spread over a period of thirteen years. Construction progress is estimated at from $2\frac{1}{2}$ to 5 miles a year, and the loan installments will be issued in such amounts as will guarantee continuous progress until completion. It will be noted in the article on the Reconstruction Budget, published in this number, that the Imperial Diet has restricted the external borrowing powers of the city of Tokyo for the five-year reconstruction period ending 1929 to Y.100,000,000, and furthermore, the city will operate under a deficit until the expiration of that period, after which it will pile up a surplus large enough to permit it to meet all ordinary expenses.

Under the present system of taxation it is difficult to dissociate the central and prefectural governments from any loan which might be issued for the benefit of Tokyo, as in these matters the jurisdiction of the three authorities so overlap as to make them all more or less responsible for any debt incurred by the city, although such guarantee be not expressly stipulated in the bond. As a matter of fact, almost ninety per cent. of the municipal revenues from taxation are derived from surtaxes imposed on national and prefectural taxes laid on the city.

In connection with the construction and financing of the subway system it is expected that the rate of progress will bring enough mileage under operation by the end of the third year to assure a certain amount of revenue from fares collected. The full earning capacity of the system will not be reached until its completion, and in the meantime the loss in revenues will be met from the proceeds of temporary loans secured on the surplus profits of the lines after the eleventh year. In fact, full and detailed plans for financing, based on a most thorough survey of present and future traffic conditions and the municipal resources, have been carefully drawn up by experts and submitted to the searching scrutiny of the Ministry of Finance and the Municipal Assembly.

The five subway lines which were approved by the Municipal Assembly on December 24, 1924, and by the Railway Ministry in May, are as follows :

1st Line: (Reserved for the Tokyo Underground Railway Co.)

2nd Line: Commencing at Meguro, running to Osaki, Tengenji Roppongi, Iigura, Sakuradamon, Kajibashi, Nihonbashiku, Honkoku Cho, Asakusa Bashi, and Morita Cho to Minami Senju : 10.5 miles.

3rd Line: Commencing at Shibuya, running to Akasaka Mitsuke, Toranomon, Kyobashi-ku, Hiyoshi Cho, Sukiya Bashi, Eiraku Cho, Shohei Bashi, Hongo San Chome, Hongo-ku, Sabana Machi, to Sugamo : 9.9 miles.

4th Line: Commencing at Yodobashi, running to Hanzomon, Sakuradamon, Sukiya Bashi, Tsukiji, Nihonbashiku, Hama Cho, Yokoyama Cho, Mikura Bashi, Uyeno Hirokoji, Hongo-ku, Masago Cho, Otsuka, to Nakano Machi : 12.5 miles.

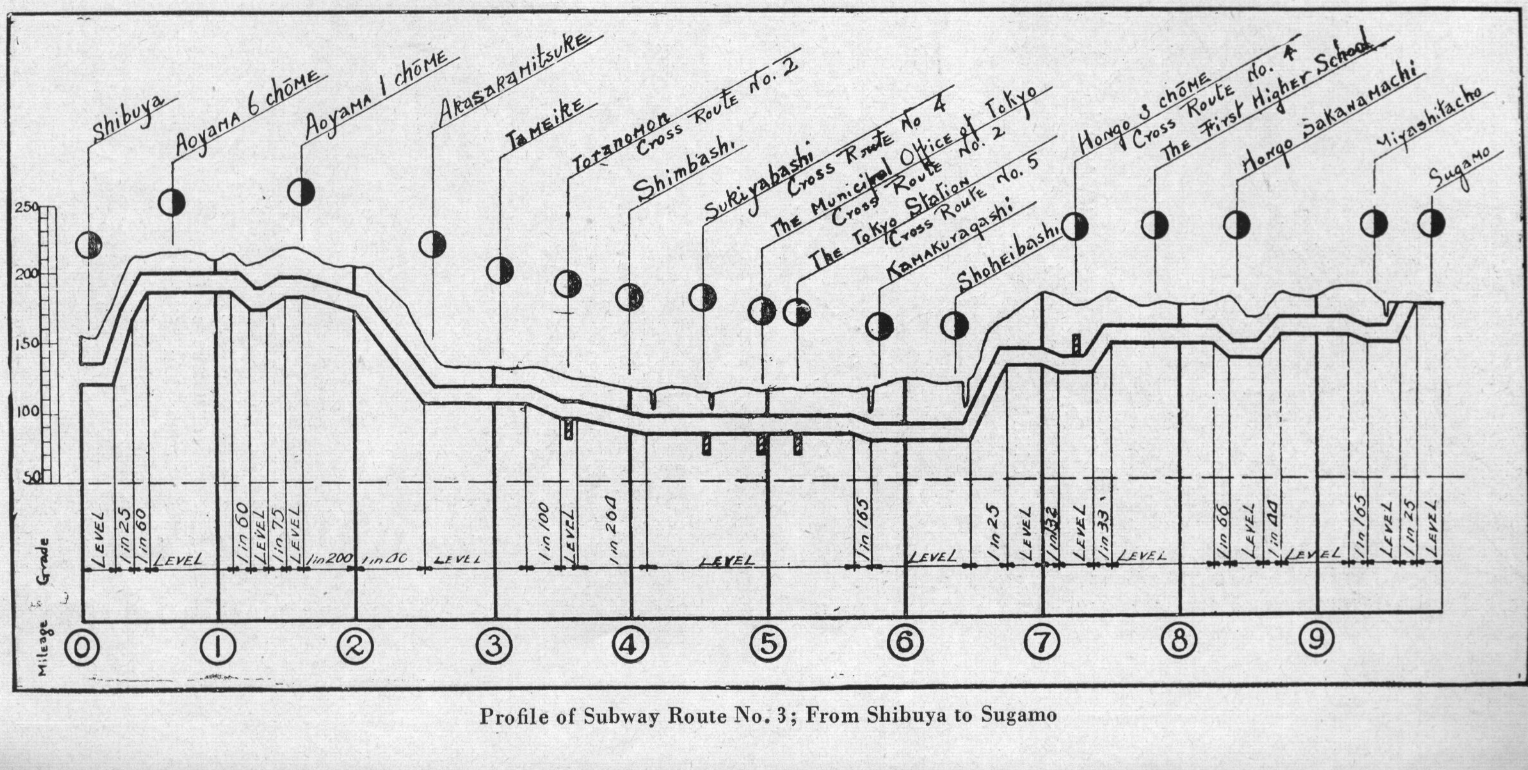
5th Line: Commencing at Nishi Sugamo Machi, running to Ushigome-ku, Kikui Cho, Iida Bashi, Hitotsu Totsuka Bashi, Eiraku Cho, Nakabashi Hirokoji, Eitai Bashi, to Fukagawa and Nishi Hirai Bashi : 8.66 miles.

Total 41.56 miles.

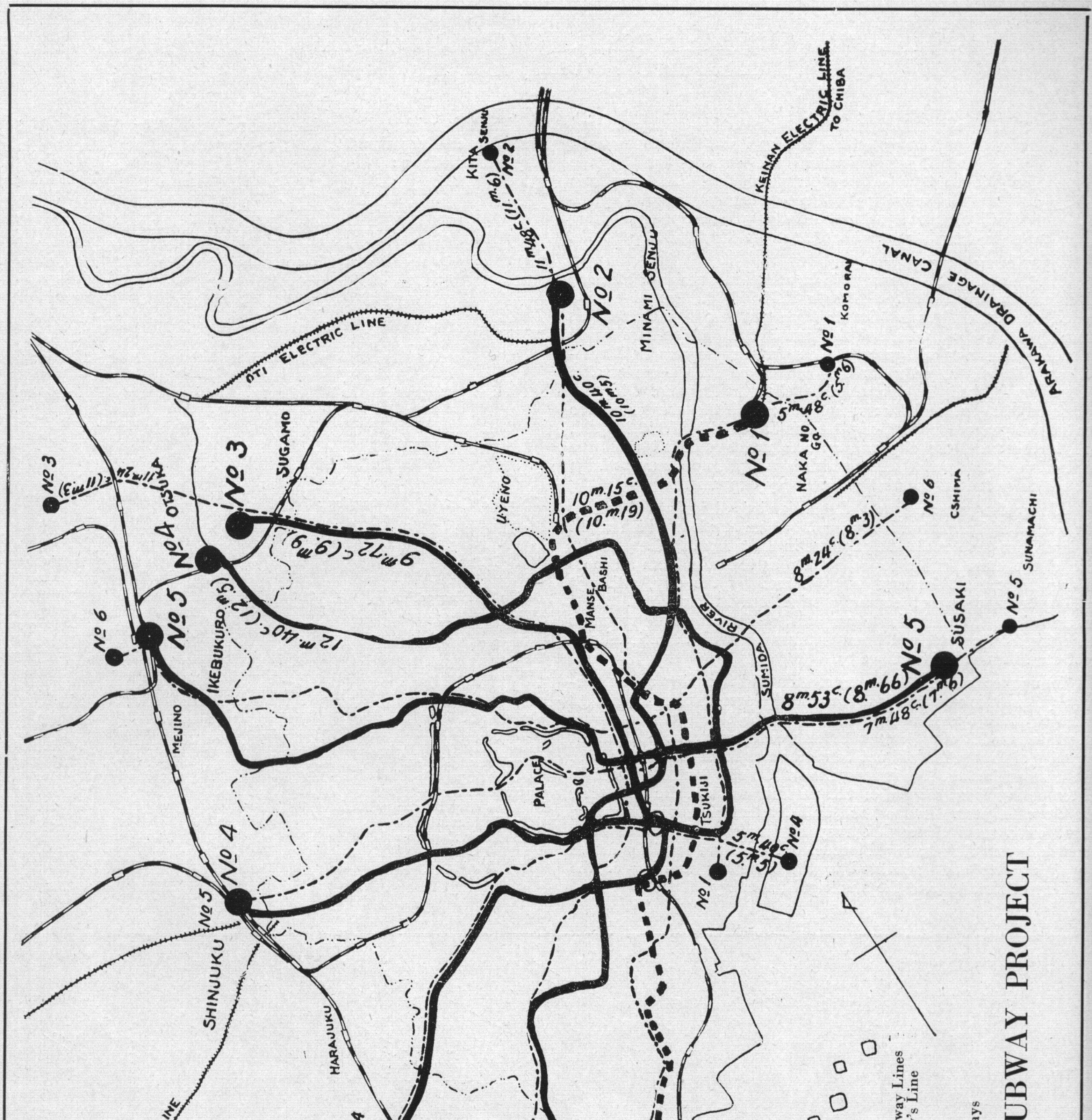
Estimated Costs of Construction :

Mileage : 41 miles 45 chains.

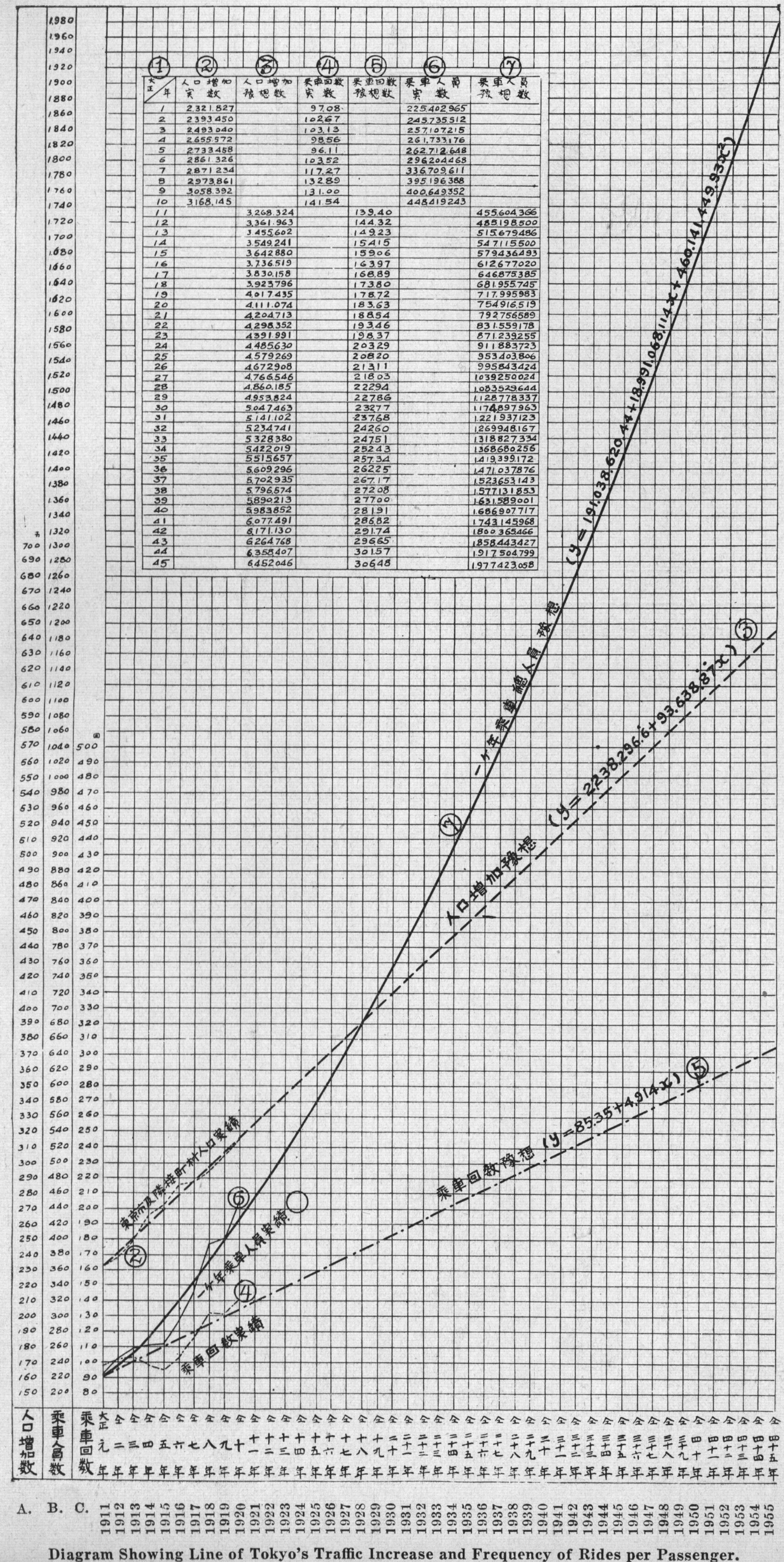
Items	Units	Unit Cost Yen	Total Cost Yen
Design and Inspection ...	41.56 miles	80,000 p.m.	3,324,800
Land	35,315 tsubo	200 per tsubo	7,063,800
Excavating	8,448 feet	40 per foot	337,920
Bridges	13,860 feet	375 per foot	5,197,500
Tunnels	197,142 feet	625 per foot	123,248,598
Track	91.4 miles	57,000 per mile	5,209,800
Stations	67 places	101,791 each	6,820,100
Cars	500	40,000 each	20,000,000
Various Buildings			83,100
Communication Lines ...	41.56 miles	1,000 per mile	41,560
Power Lines	41.56 miles	120,000 per mile	4,987,200
Transformer Stations ...	19,000 k.w.	120 per k.w.	2,280,000
Car Buildings...	41.56 miles	10,000 per mile	415,600
Equipment for construction	... ...	... ...	1,245,500
Right of Way Boundary Marks	... ...	... ...	20,780
Office Expenses	... ...	... ...	4,156,522
Preliminary Expenses ...	... ...	... ...	2,588,000
Total	... ...	... ...	Y.186,820,780
Average Cost per Mile	... ...	... ...	4,500,000



Profile of Subway Route No. 3; From Shibuya to Sugamo



TOKYO'S SUBWAY PROJECT



① 大正 年	② 人口増加 実数	③ 人口増加 豫想数	④ 乗車回数 実数	⑤ 乗車回数 豫想数	⑥ 乗車人員 実数	⑦ 乗車人員 豫想数
1	2,321.827		97.08		225.402.965	
2	2393.450		102.67		245.735.512	
3	2.493.040		103.13		257.107.215	
4	2.655.572		98.56		261.733.176	
5	2733.458		96.11		262.712.648	
6	2861.326		103.52		296.204.468	
7	2.871.234		117.27		336.709.611	
8	2973.861		132.89		395.196.388	
9	3058.392		131.00		400.649.352	
10	3168.145		141.54		448.419.243	
11		3.268.324		139.40		455.604.366
12		3.361.963		144.32		485.198.500
13		3.455.602		149.23		515.679.486
14		3.549.241		154.15		547.115.500
15		3.642.880		159.06		579.436.493
16		3.736.519		163.97		612.677.020
17		3.830.158		168.89		646.875.385
18		3.923.796		173.80		681.955.745
19		4.017.435		178.72		717.995.983
20		4.111.074		183.63		754.916.519
21		4.204.713		188.54		792.756.589
22		4.298.352		193.46		831.559.178
23		4391.991		198.37		871.239.255
24		4.485.630		203.29		911.883.723
25		4.579.269		208.20		953.403.806
26		4.672.908		213.11		995.843.424
27		4.766.546		218.03		1.039.250.024
28		4.860.185		222.94		1.083.529.644
29		4.953.824		227.86		1.128.778.337
30		5.047.463		232.77		1.174.897.963
31		5.141.102		237.68		1.221.937.123
32		5.234.741		242.60		1.269.948.167
33		5.328.380		247.51		1.318.827.334
34		5.422.019		252.43		1.368.680.256
35		5.515.657		257.34		1.419.399.172
36		5.609.296		262.25		1.471.037.876
37		5.702.935		267.17		1.523.653.143
38		5.796.574		272.08		1.577.131.853
39		5.890.213		277.00		1.631.589.001
40		5.983.852		281.91		1.686.907.717
41		6.077.491		286.82		1.743.145.968
42		6.171.130		291.74		1.800.365.466
43		6.264.768		296.65		1.858.443.427
44		6.358.407		301.57		1.917.504.799
45		6.452.046		306.48		1.977.423.058

A. B. C. 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939 1940 1941 1942 1943 1944 1945 1946 1947 1948 1949 1950 1951 1952 1953 1954 1955

Diagram Showing Line of Tokyo's Traffic Increase and Frequency of Rides per Passenger.

A, Increase of Population. 2, No. of Passengers Using Trams. 3, Frequency of Rides. 1, Years Taisho Era (1912-1956) : 2, Actual Increase of Population ; 3, Estimated Increase of Population ; 4, Actual Number of Car Rides ; 5, Estimated No. of Car Rides ; 6, Actual No. of Passengers

Distance between Stations :

Number of Line	Length miles	Number of Stations	Average Distance between Stations. Miles
2	10.5	8	0.80
3	9.9	17	0.65
4	12.5	18	0.73
5	8.66	15	0.61
Total	41.56 miles	67	0.653 miles, average.

Speed of Trains and Headway :

Length of Stop at Stations,. Seconds.	Miles per hour	Time between trains, seconds. 3 car trains	4 car trains	5 car trains	8 car trains	10 car trains
15	15.8	78	80	81	85	87
30	17.6	93	95	96	100	102
45	15.8	108	110	111	115	117
60	14.5	123	125	126	130	132

Taking the number of passenger per car, 125, as **n**, and the time between cars as **P**, the transportation efficiency of the system per hour is expressed by $\frac{450{,}000\ n.}{P}$

Length of Stop at Stations. Seconds.	Passengers carried, in thousands. 3 car trains	4 car trains	5 car trains	8 car trains	10 car trains
15	17.3	22.5	27.8	41.4	51.7
30	14.5	20.0	23.4	36.0	44.1
45	12.5	16.4	20.3	31.3	38.5
60	11.0	14.4	17.9	27.7	34.1

It is estimated that the 49.9 miles of double track on which trains are run for 19.5 hours in every 24 hours at a speed of 16 miles, stopping at stations 45 sec., each car of each train carrying 40 per cent. of capacity, 125 persons, and each passenger riding 4 miles, the number of passengers the system can carry annually will be as follows :

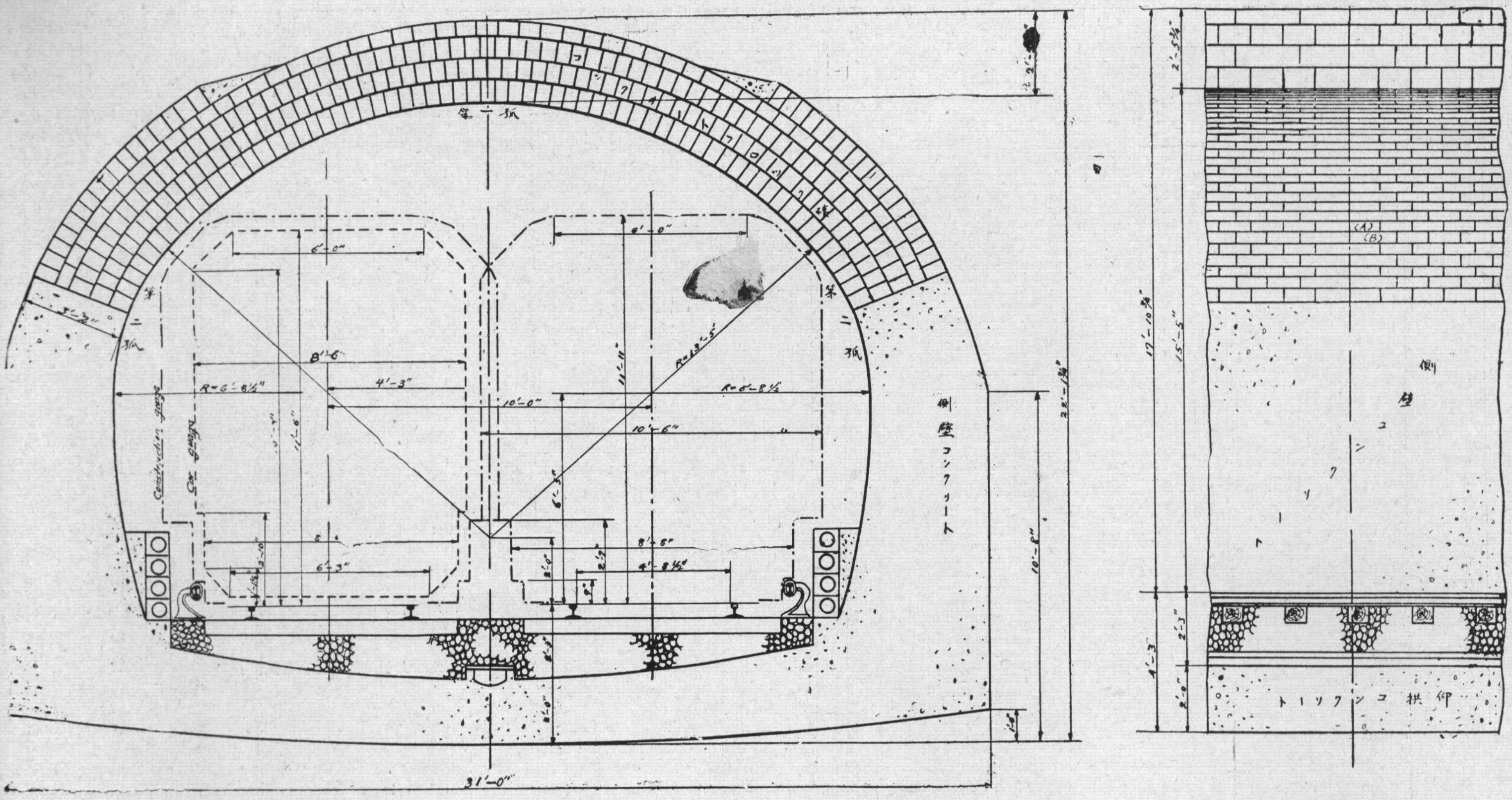
Number of Cars per Train	Time between Trains	Annual Passenger Number.
3	108	735,000,000
4	110	1,149,000,000
5	111	1,196,000,000
8	115	1,847,000,000
10	117	2,252,000,000

Each train running 45 minutes apart can handle 38,000 passengers per hour at any one station on the line.

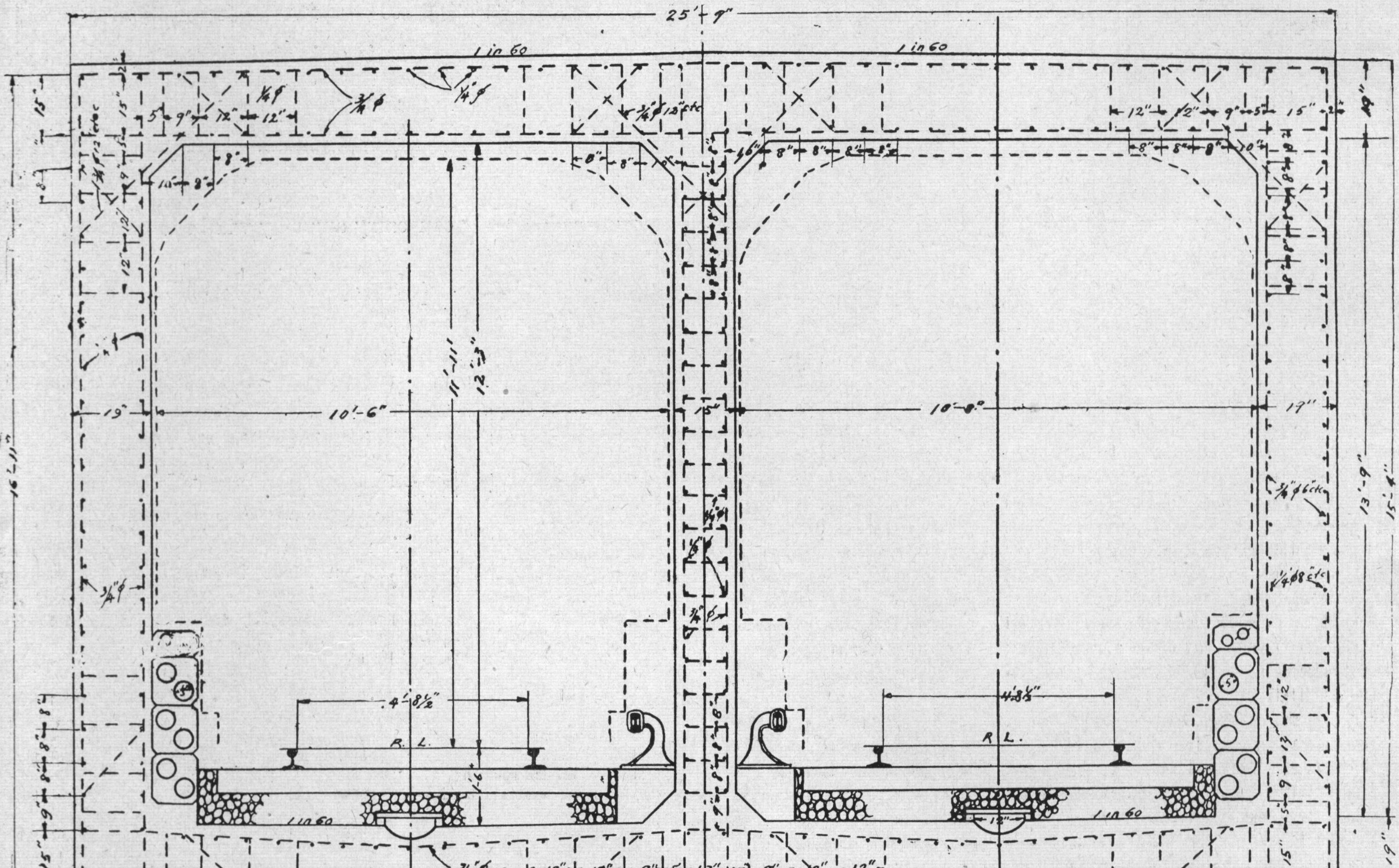
Before committing the city to the construction of the subways, the authorities conducted a most thorough and searching investigation into the traffic needs of the metropolitan district for the next twenty years, basing their estimates on the experience of other large cities in Europe and America. These figures have been checked, and only after receiving the approval of the financial and railway experts did the Municipal authorities decide to proceed with the work.

The growing city of Tokyo is now served by 195 miles of surface tramways operated by the municipality. This is exclusive of the high-speed overhead electric railway service encircling the city operated by the Imperial Railway Department (see article on "Electrification of Railways") and the several private and municipal motor-bus lines. In the last fiscal year ending March 31, 1925, the total number of passengers carried by the surface lines was 480,000,000, and it is estimated that this will increase to 530,000,000 during the current year. Owing

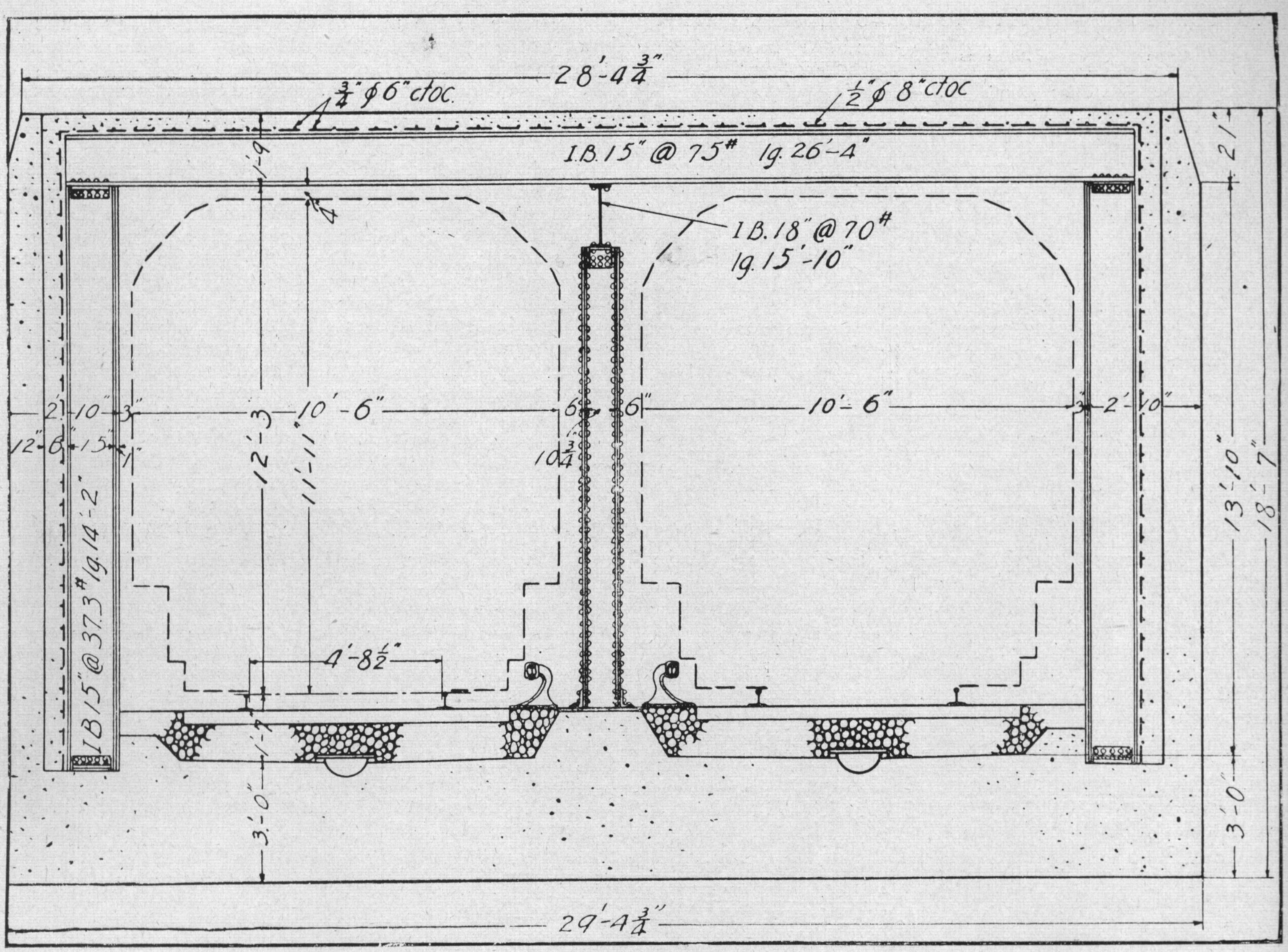
Previous Page - Notes cut off from page bottom:
4. Actual Number of Car Rides; 5.Estimated No.of Car Rides;
6. Actual Number of Passengers; 7. Estimated Number of Passengers



Arched Section of New Subway.



Rectangular Section of Subway.



RECTANGULAR SECTION OF SUBWAY.

Table of Materials: Concrete, 24,374 lbs, 174.1 cv. ft; I Beams, 1817 lbs, 3.79 cv. ft; Mild Steel, 158.3 lbs, 0.33 cv. ft.; Conveying of Remaining Earth, 53,762 lbs., 537 624 cv. ft. (2.489 cv. tsubo)

of the surface lines by the street plans of the Reconstruction Bureau, only 372 miles, or about twice the present mileage, can be operated within the city limits. Even with this mileage it will be impossible for the surface lines to adequately handle the rapidly increasing traffic from the fast growing suburban districts whose development is proceeding at a pace out of all proportion to the transportation facilities. This is specially true since the earthquake of 1923, which compelled thousands of homeless people to settle in the outlying districts who now decline to return to the overcrowded city. So great indeed has been the growth of the suburbs that, comparing it with similar conditions in Europe and America, it is estimated that by 1930 the Tokyo surface tramways will be called upon to handle over 700,000,000 passengers a year, increasing to 900,000,000 in 1935 and to more than 1,300,000,000 in 1945.

The traffic limit of the Tokyo surface lines is placed at 600,000,000 annually, so the only solution to the transportation problem lies in the immediate construction of subways to handle the long-haul traffic from the suburbs now pouring into the city through the many private railways serving these sections and transferring at the city limits to the surface and overhead electric lines. The great bulk of this traffic is destined for the business and shopping center of the city, which for all practical purposes may be taken as the Tokyo Central Railway Station. In estimating the number of passengers that would be diverted to the subways, the traffic experts arrive at the following very conservative figures for the No. 3 Subway Line, starting at the Shibuya terminal and ending at the Tokyo Central Station and then taking the other half of the same line from Sugamo into the Central Station. The table gives the number of passengers per mile per day based on the traffic results for the fiscal year 1923. In arriving at the percentage of passengers diverted to the subway, the calculations are based on the returns of the present surface tramway, motor bus and overhead electric services.

NO. 3 SUBWAY LINE—SHIBUYA TO TOKYO CENTRAL STATION

	Section	Passengers	Subway %	Estimated Passengers	Miles Carried	Passengers per mm. per day
	By Surface Tram Lines :					
From	Shibuya Terminal ...	25.940	70	18,158	4.6	83,527
,,	Aoyama 4-chome ...	20,060	65	13,039	4.0	52,156
,,	Kasumi-cho	18,760	50	9,380	3.5	32,380
,,	Sakurada, Hongo-cho, to Tokyo Central Station	12,950	30	3,885	1.3	5,051
	Total	77,710	57.2	44,462	3.9	173,564
	By Motor Bus					
,,	Shibuya	4,500	65	2,925	4.2	12,285
,,	Sakurada, Hongo-cho, to Tokyo Central Station	900	30	270	1.3	351
	Total	5,400	59.2	3,195	3.95	12,636
	By Gov't. Electric Line :					
,,	Shibuya and Harakujo...	3,690	70	2,583	4.6	11,882
,,	Ebisu and Meguro ...	6,560	70	4,592	4.6	21,123
	Grand Total ...	93,360	58.7	54,832	3.99	219,205
	SUGAMO TO TOKYO CENTRAL					
	By Surface Tram Lines :					
,,	Sugamo Line	35,780	65	23,257	4.0	93,028
,,	Otsuka Terminal ...	36,930	65	24,005	4.3	103,222
,,	Kumagome Terminal ...	27,900	65	18,135	4.3	77,981

NO. 3 SUBWAY LINE—SHIBUYA TO TOKYO CENTRAL STATION

Section	Passengers	Subway %	Estimated Passengers	Miles Carried	Passengers per mm. per day
By Surface Tram Lines (Continued).					
From					
,, Sudacho to Tokyo Cent.	24,570	30	7,401	1.3	9,621
,, Increase en route ...	15,800	50	7,900	3.5	27,650
Total	141,080	57.2	80,698	3,86	311,502
By Motor Bus :					
,, Sugamo Line	1,800	65	1,170	4.0	4,680
,, Gokokuji Line	720	30	216	1.5	324
,, Sudacho to Tokyo Cent.	504	30	151	1.3	197
Total	3,024	50.8	1,537	3.4	5,201
By Gov't. Electric Line :					
,, Otsuka, Sugamo and Kumagome	440	65	286	4.3	1,230
,, Meijiro and Ikebukuro ...	3,080	65	2,002	4.3	8,609
Total	3,520	57.3	84,523	3.86	326,542
Aoyama Section ...	219,205—3.99		54,938 passengers.		
Sugamo ,, ...	326,542—3.86		84,596 ,,		
	545,747—7.86		69,521 passengers		

It will be seen from this extremely conservative estimate based on the traffic returns of the surface, overhead electric and motor bus services for 1923, that No. 3 Subway Line may fairly expect to get 69,521 passengers per day, or, say, 25,000,000 in one year. At an average fare of 10 sen this gives a revenue of Y.2,500,000. This line is 10 miles in length and will cost about Y.45,000,000 to build and equip. At eight per cent. to cover the service on the construction loan, or Y.3,600,000, the deficit must be made up from other sources, or, as is contemplated, by temporary loans secured on the excess profits after the line is meeting its obligations. Within ten years, at the present rate of increase, this line will be handling over 50,000,000 passengers per year, producing a revenue of Y.5,000,000.

Reference to the map of the proposed subway routes will show that the other three Municipal lines all connect with important suburban railways, and converge in the heart of the city at the Tokyo Central Railway Station. Careful estimates of the probable subway traffic for these other lines, showing equally satisfactory results, have also been worked out by the experts.

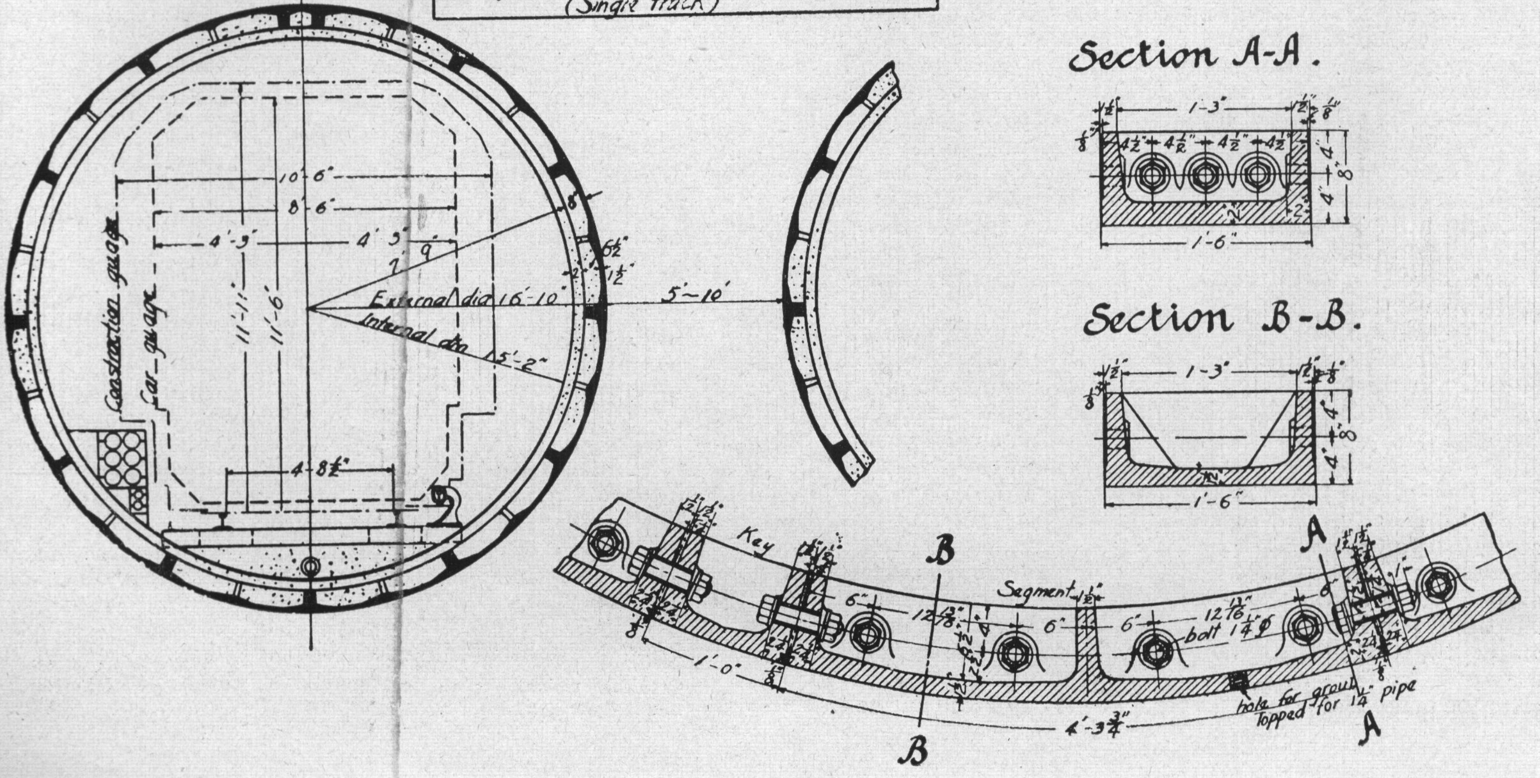
The tendency to make Tokyo an industrial city as well as the financial and political capital is responsible for its rather abnormal increase of population as compared with other parts of the empire. People are flowing into the metropolitan district from the country districts at such a rate that the urban population is increasing four times as rapidly as other Japanese cities, and this tendency is bound to continue rather than diminish owing to the annual increase of population in Japan of over 700,000. The limited opportunities for gaining a livelihood in the country are forcing these people into the cities, with the result that the industrial districts of Tokyo and the new manufacturing centers in nearby towns will continue to absorb a large part of this surplus. Traffic in Tokyo will grow in geometric progression along the same lines as other great cities, and the attached diagram showing the line of traffic increase based on the law of the least square and the frequency of rides per person shows that by 1945 Tokyo's transportation system will be called upon to handle nearly 2,000,000,000 passengers per annum.

The concentration of business and shopping in a restricted area of less than a mile square is responsible for the usual rush hour traffic, which in Tokyo is already beyond the capacity of the surface lines to cope with. Eighty per cent. of the traffic during these morning and evening rush hours is bound in and out of the central district. Some idea of the increase of population in Tokyo and its 27 suburban towns and villages is seen in the figures for the eight-year period 1912-1920. During this time the urban population increased from 2,009,980 to 2,377,884, or only 18 per cent., while the 27 suburbs increased from 342,401 to 732,709, or 114 per cent. Since 1922 the rate of increase in the suburbs has been much greater, and it may be estimated that at this time they have grown to over 1,000,000.

Table of Materials.

Kind	Weight	Volume	Number	Total Wt.(ton)
Segment	0.430 ton	2.007 cub ft	12	5.16
Key	0.133 ton	0.619 "	1	0.133
Concrete		0.173 cub. tsubo		2.338
Mortar		0.007		0.081
Bolt	5.288 16.5		88	0.208

Total Wt. = 7.92 ton
Single track per ft run = 5.28 ton
Double " " = 10.56 ton
Excavation (Single track) 1.03 cub tsubo/lin ft
Conveying of remaining earth 1.03 cub. tsubo/lin ft (Single track)



Cross Section of Tube Tunnel, Showing Construction and Details, Detail of Cast Iron Lining (right)

Restoration of Communications System

By SANNOSUKE INADA

Chief Engineer of Technical Section, Department of Communications, Japan

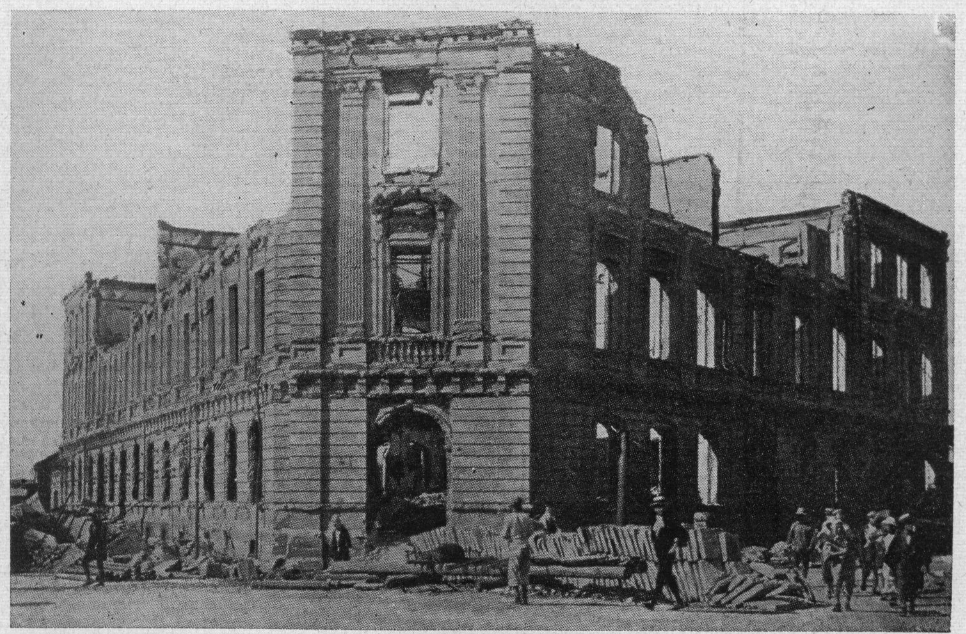
(Reprinted from "The Far Eastern Review," March, 1925)

THE Tokyo earthquake caused severe damage to the telegraph and telephone installations in Tokyo, Yokohama and their vicinities; and a majority of the office buildings, equipments, and line plants in these localities was reduced to ashes by the conflagrations which spread immediately after the quake. Damages to these installations were so serious that they can never be fully stated in detail, but it is intended that general descriptions concerning them shall be given.

Damages to Installations

The number of the first and second-class offices damaged is given below:

Districts	No. of Burnt or	Offices Wrecked
Tokyo and its suburbs	23	13
Province of Kanagawa	8	7



General View of Tokyo Telegraph Office after Fire

The line plants connecting and terminating at the above offices were wiped out by conflagrations. The damages to the Tokyo central telegraph office caused not only an interruption of the entire central service of telegraphic function in Japan, but also of her international communications.

As soon as the quake occurred the 350 telegraph circuits which terminate at the Tokyo central telegraph office came to faults of contacts and earth; and the electrical source for the telegraph was shut down by the tumbling down of the secondary batteries. Thus all the circuits were interrupted, and at the same time all employees, rushing outdoors, barely escaped being crushed by the destruction of walls on the third floor. As this building was very old, a new central office in the centre of the city was in course of construction, reinforced concrete being used throughout. In spite of all efforts of the employees, all installations were reduced to ashes by fire on the evening of the first day, the principal equipment lost being as follows:

Equipment	*Number Lost*
Wheatstone automatic transmitter and receiver	126
Quadruplex and simultaneous A.C. and D.C. duplex	Sets for 19 Ccts. and spare
Duplex and combined Dx-Sx.	Sets for 65 Ccts. and spare
Simplex	Sets for 138 Ccts. and spare
Syphon recorder duplex (for Bonin and Guam cable)	1 complete set
High frequency simplex	1 complete set
Western electric quadruple-duplex printer	1 complete set
Western electric start-stop printer ..	1 complete set
Teletype	2 sets
Kleinschmidt keyboard perforator ..	17 sets
Telegraph switchboard	2 sets
Monitoring set	5 sets
Pneumatic tube equipment	14 sets
Ticker	126 sets
Testing equipment	Complete set

The underground cable between Tokyo and Yokohama was burnt or crushed in Yokohama and near the river Rokugo, and totally damaged near the river Banyu, where the cables were suspended by arms attached to the piers of the railway bridge. Disaster in the vicinity of Hakone was so serious that no pole line remained on account of the cracks and failures in the ground. One may easily gauge the magnitude of the disaster by referring to Figure 1, which shows the damage done to a pole line in Yokohama.

As a result of the first quake, the Guam cable, the only cable which connects Japan with the United States of America, went down to fault and was interrupted. For urgent repairs the *Okinawa Maru* was ordered to steam hastily from Nagasaki, and after strenuous endeavors, co-operating with two other cable ships, *Ogasawara Maru* and *Nanyo Maru*, faults were cleared on October 27. The latter cable ship, being then anchored at Yokohama, supplied cables and other materials needed for the repair to the *Okinawa Maru*, and the former made hasty trips to supply the necessary cables, carrying them from the cable tank at Nagasaki. The faults of this cable were grappled at 16 points along the route, at distances from 44 to 75 knots from Etchujima cable house, where this cable is landed, operating both inside and outside of Tokyo bay at depths of sea measuring from 300 to 1,160 fathoms. Locations of these faults were as follows:

Fault	*Distance along Cable from Etchujima*
Point No. 1.	About 44.5 knots (about 5 knots off Kachiyama, westward)
Point No. 2.	About 45.5 knots
Point No. 3.	About 46.1 knots
Point No. 4.	About 46.6 knots
Point No. 5.	About 66.6 knots
Point No. 6.	About 74.1 knots (about 10 knots off Habu harbor in Oshima, westward)

According to investigations, it seems that these faults were due to sudden shocks which were caused by the earthquake. The faults were breaks and grounding, and from an inspection of the faulty parts of this cable it was noted that it was broken with no elongation of armor steel, but as if a tremendous stress had been applied suddenly. By the fact that at some points the cable seems entangled forcibly, it can be imagined that these faults might have occurred at points where some part of the cable was buried under the sea bed according to its sudden change.

It may be added, in passing, that the condition of damage on the Sakurajima submarine cable, which connected Kagoshima and Sakurajima island, and which was affected by the eruption of Sakurajima island of January 1914, was nearly the same as that of the Guam cable above mentioned. At one or two feet from the end of the cable break the inner serving of the former cable was snapped at quite numerous points.

The underground portion of the Guam cable from cable house to Tokyo central telegraph office, which is of four cores of I.R. cables, was also burnt at several bridges on its route, but was repaired before communication between Tokyo and Guam was restored.

Figure 1.—Cracks in Ground Near a River in Yokohama. Telephone Pole near Centre of Picture

Emergency Measures

As a consequence of the entire breakdown of the Tokyo central telegraph office system, it was planned on the afternoon of the very day of the disaster to open a temporary telegraph office in the building of the communications officers' training institution in Shiba park, but that plan fell through completely, as the building was burnt in the early morning of the second day. Thereupon it was decided, first of all, to connect Tokyo with other important cities at some point in the suburbs of Tokyo. For this purpose Senju office, which is situated in a part north-east of Tokyo, was chosen from the standpoint of routing. Communication concerning relief business was successfully opened with Osaka, Nagoya and Sendai at 11 p.m. on the second day. As shown by the map (Figure 3), the central and the busiest portion, or nearly one-half of the area of the city of Tokyo, was burnt; it was a very difficult task to find an appropriate site for the central office.

For convenience sake it was planned to open the temporary central telegraph office in the building of Tokyo central post office, which fortunately escaped the fire. After much effort instruments and materials were gathered from all districts. On the other hand, by jointing together underground cables of telegraph and telephone, which remained undamaged in the city, it was possible to open communication from the centre of the capital to the cities of Osaka, Nagoya, Nagasaki, Kobe, Sapporo and Nagano one after another in the period from the fifth to eighth day. At the same time a temporary circuit between the central office and the radio station in the telegraph corps at Nakano, a suburb of Tokyo, which served to connect other radio stations and the central office, was constructed by a force from the telegraph corps.

On the 14th the temporary Tokyo central telegraph office was removed to the fourth floor of Eiraku building, where emergency circuits terminating at Senju, Kameido and other places were cut over together. Thus the organization of the plant of the Tokyo central telegraph office was consolidated, which had been rather disorganized since the day of the disaster. Later, the number of circuits which terminated at this office were gradually increased, making a total of 65 on November 11, and they afforded efficient service to all quarters of Japan.

At Yokohama, as the damages done to that city were so serious that many of our employees were killed and injured, any sort of planning of emergency measures was very difficult. As nothing could be done in the centre of the city a temporary office was established at Kanagawa station of the inter-urban electric railway between Tokyo and Yokohama. On September 12 a telegraph service was offered to the public, but with some restrictions, serving relief messages only as in Tokyo. Communication from Yokohama to Kamakura and Yokosuka was commenced on the 17th. On October 24, after removal of the temporary office to the barracks at Sakuragi-cho, communication with Osaka, Shizuoka, Maebashi, Kyoto, Sannomiya and other places was re-opened.

Traffic in the districts outside the affected area increased extraordinarily, especially at Osaka, where it came up to over twice the daily service before the disaster, amounting to something over 188,000 messages on September 5. At Sannomiya foreign messages dispatched during the first ten days of September increased by 80 per cent. in the number of messages and 250 per cent. in the number of words in daily average. As temporary measures for this extraordinary condition circuits as direct as possible from Tokyo to the cities in Chugoku, Kyushu and north-east districts were chosen, making use of circuits which were interrupted. Although unexpected, owing to the make-up of the temporary circuits involved, satisfactory results were obtained by putting the duplex Western Electric type printer in use for foreign messages between Osaka and Nagasaki.

Damages to the Telephone

I. Damages to the Office Buildings

Number of centrals and the extent of damages sustained fromthe earthquake calamity are given in a table elsewhere in this article.

In Yokohama the central Honkyoku was, as shown in Figure 5, wrecked entirely and many employees were killed or injured there. In Tokyo, the central Kyobashi was, as shown in Figure 6, destroyed at its corner, and several employees here also were killed or injured, the building afterwards burning to ashes. The centrals Shiba, Kanda, Naniwa, Shitaya and Honkyoku, being of brick construction, were damaged seriously and burnt to ashes afterwards. The central Kudan was damaged so seriously that it cannot be used again, owing to the cracks in the walls or unrepairable damages to the main structures. As for the remaining centrals such as Sumida, Ginza, Hamacho, Horidome and Asakusa, damages were comparatively slight, and these might be used again by simple repairs. By the conflagrations which spread immediately after the quake all these centrals lost all the equipments, furniture, etc., the main structures of reinforced concrete alone being saved.

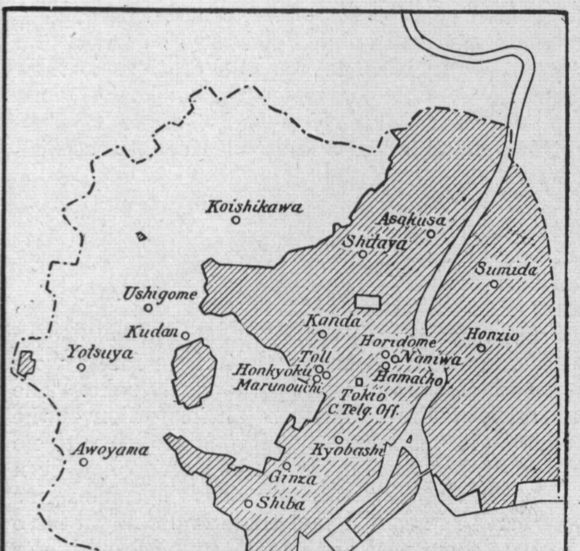


Figure 3.—Map of Burnt Area in the City of Tokyo

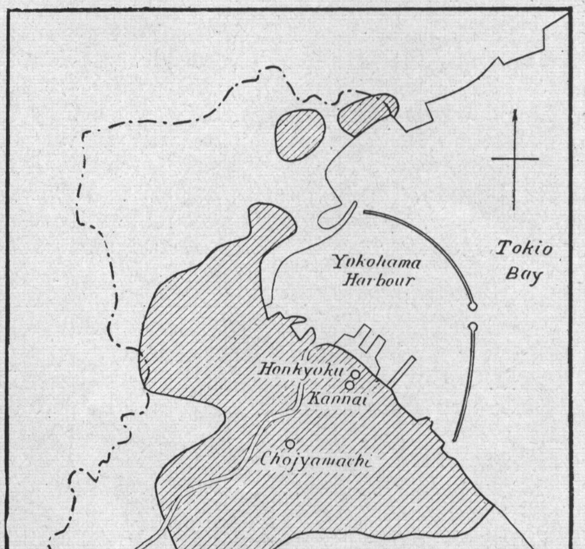


Figure 4.—Map of Burnt Area in the City of Yokohama

Figure 5.—General View of Ruins of Telephone Central Honkyoku, Yokohama

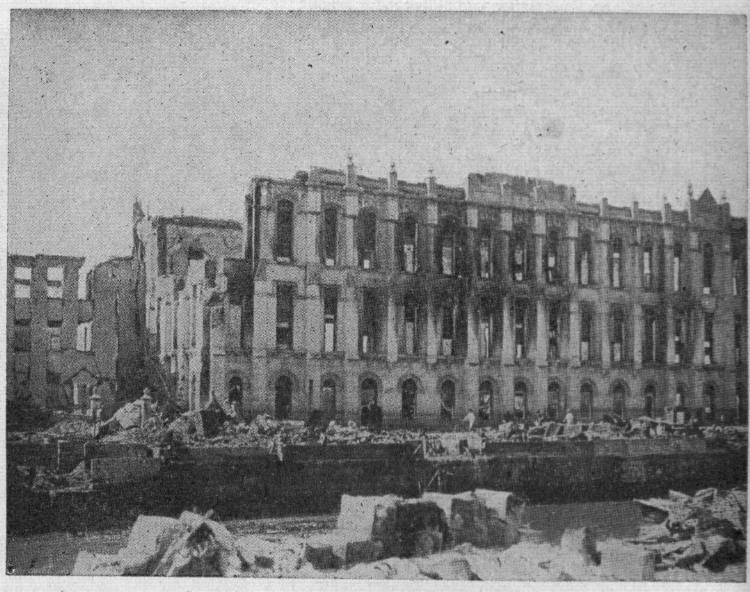


Figure 6.—Outside View of Telephone Central, Kyobashi, Tokyo, After Fire

Thus all the centrals in Yokohama were shut down. In Tokyo two centrals, Kudan and Yotsuya, were not burnt, but became unavailable; 14 of them burnt completely with their equipments; and only four remaining were capable of being opened to renew their service, namely Koishikawa, Ushigome, Awoyama and Takanawa.

City	*Extent of Damage*	*Number of Offices*	*Type of Building Construction*	
	Damaged beyond repair	8	Stone work	1
			Reinforced concrete	7
Tokyo	Structure only saved — equipments, furniture, fittings, etc., burnt—available by repair and re-equipment	7	Reinforced concrete	
	Available by reinforcing, though seriously damaged — equipments not burnt	1	Reinforced concrete	
	Available by repairing—equipments not burnt	4	Reinforced concrete	
Yokohama	wrecked almost completely and burnt	1	Brick work	
	Structure only saved — equipments, furniture, fittings, etc., burnt—available by repairing...	1	Reinforced concrete	
	Available by repairing—structure only saved	1	Reinforced concrete	

II. Damages to Office Equipments.

At the instant of the severe shock some of the switchboards rocked backwards and forwards, cable runways dropped, M.D.F. and I.D.F. deformed in a corrugated way, becoming wavy, relay racks inclined, and meter batteries tumbled down. While these damaged parts were being investigated and restored as soon as possible in order to resume the service the fires started at nearly every part of the city, and spread out at a tremendous rate. While it was impossible at the time to investigate fully the extent of damages done to the equipments in each office, the six surviving centrals were investigated more fully. It should be remembered that the extent of the damage was different in each case, some so slight as loosened bolts, disorder of relay adjustment and running over of electrolyte of storage batteries. These slight damages were present even in the cases denoted as "right" in table on following page showing the condition of damages in six surviving centrals.

A description is given here of the condition of the batteries which is applicable to all the centrals, and which is of interest in connection with improvement of setting in telephone offices. Damages to other kinds of equipment will be described later.

Figure 2. —Map of the Quake Area on September 1, 1923

Electrolyte in cells ran over more or less in all the centrals. The glass type cells for register use (40v) were arranged on two wooden frame shelves, upper and lower, and some of the cells on upper shelf fell down and were broken.

None of the cells of the common battery (24v), which were in lead-lined wooden tanks, tumbled, as they were set on the floor and were, therefore, stable. Among damages done to the common batteries in the centrals, Yotsuya, Ushigome and Awoyama, the following may be mentioned. Ears of the active plates were melted as a consequence of short circuit, due to breaking of the supporting side glasses, although they were of a standard size of secondary cell maker. In the case of two cells in Awoyama buckling of plates, which was occasioned by the falling of active materials, caused short circuit of the plates, thereby introducing a small hole in the lining of the tank, which led to running out of electrolyte. This hole, so small as not to be visible, seems to have been caused by sparks at a point where the active materials made a partial contact with the lead-lining. While the above batteries were of the G.S. type made in Japan, those in the centrals Takanawa and Koishikawa were of the Tudor type, and in the latter case there happened no such damage as mentioned above. The difference in the condition of both instances above cited is probably due to the difference in the thickness of the supporting side glasses.

The generating equipments in all centrals were undamaged owing to the good foundations; especially so was this the case in Sumida central. As fire was not so serious there, 10 among 11 cells of common battery of that office

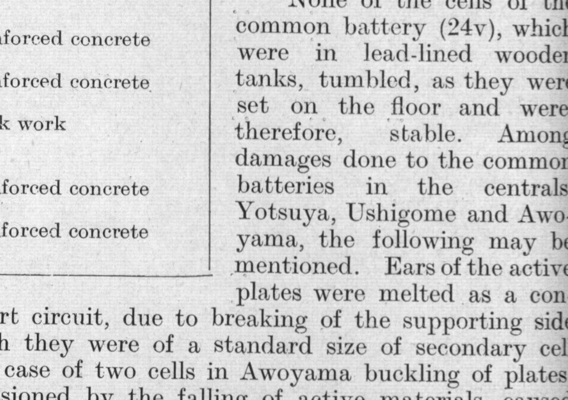


Figure 9.—Ruins of M.D.F. and Office Manhole after fire in Telephone Central, Ginza, Tokyo

Figure 7.—Ruins of Cable Room after Fire in Telephone Central, Horidome, Tokyo

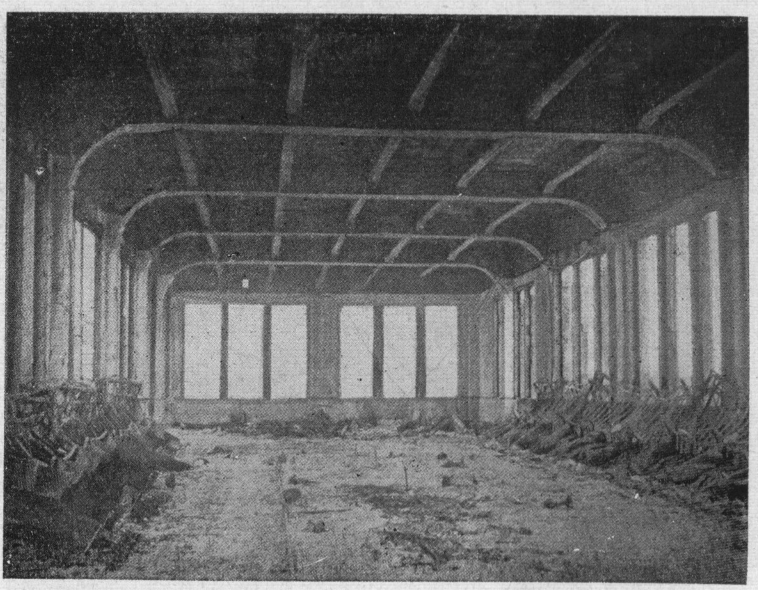


Figure 8.—Ruins of Switching Room after Fire in Telephone Central, Hamacho, Tokyo

were utilized again in another central by replacing some of the plates.

III. Damages to the Subscribers' Stations and Line Plants.

TOKYO

Facilities	*Number before Disaster*	*Burnt or Demolished*	*% Damaged*
Subscribers' stations	82,766	50,265	60.8
Poles	58,521	26,598	45.0
Arms	198,622	82,251	41.0
Aerial cable (cable length) ..	28,543 miles	12,299 miles	43.0
Pot heads	4,897	2,927	60.0

YOKOHAMA

Facilities	*Number before Disaster*	*Burnt or Demolished*	*% Damaged*
Subscribers' stations	10,340	9,740	94.0
Poles	13,350	12,600	90.0
Arms	24,700	21,600	88.0
Aerial cable (cable length) ..	104 miles	75 miles	72.0

The preceding tables show numerically the damages done to the subscribers' stations and line plants in both Tokyo and Yokohama.

In both of the cities Tokyo and Yokohama, most of the manholes were so deluged that it prevented a full inspection of damages done to the underground cables, but the following table gives the figures for cables which were penetrated by water through damages to the lead sheaths in the Tokyo area:

Cable	*Cable Length Unavailable. In Miles*	*Cable Length before Disaster. In Miles*
1,200 pr.	.33	1.00
800 ,, ...	.05	.09
600 ,, ...	17.30	52.00
400 ,, ...	50.00	150.00
200 ,, ...	101.00	302.00
100 ,, ...	24.00	120.00

As the result of inspection of cables, the following faults on the cables terminating in five centrals were found:

Cable	*Total No. of Ccts. Prepared for Subcs.*	*No. of Und. Gr. Cables Terminated*	*No. of Faults Location on Und. Gr. Cable*	*No. of Faults Location on Aerial Cable*
Koishikawa	9,000	27	0	50 pr.—15
Ushigome	7,400	12	200 pr.—1 400 pr.—1	50 pr.— 7
Awoyama	4,800	11	0	0
Takanawa	6,200	18	400 pr.—1	50 pr.— 8
Yotsuya	3,600	6	600 pr.—1	0

As the description has been of a general character heretofore, a more detailed summary will be given below:

Toll Lines: Among the damages done to the toll lines, it may be mentioned that the underground toll cable between Tokyo and Yokohama was so seriously damaged that it can hardly be repaired. This cable was installed in 1922 by the latest practice of engineering method. It is of the quadded type, medium heavy loaded, and was manufactured by the Western Electric Company in the United States of America, minute care being taken to minimize capacity unbalances not only between conductors of the pairs, but also between pair and pair. On its installation cores were chosen and spliced, so as to minimize the capacity unbalances between each circuit, at seven points in each loading section. While this cable was installed with such extreme caution as above stated, it sustained from disaster such damages as the crushing of the cast-iron conduit, sinking and shifting at the river Rokugo and other places along the route. Such painstaking labors during the cable laying was of no account, and a more minute investigation and electrical measurements will be necessary before it will again be available for the restoration of the service. The balancing at those faulty points will be more difficult than in the case of initial installation, because sufficient points cannot be obtained to make the balance.

Kind of Damage	*Amount Damaged. Miles*	*Remarks*
Cable length burnt	2.5	Total cable length before disaster was 42 miles.
No. of points of punctured or break ..	21	
No. of cables punctured or broken ..	82	
No. of locations water penetrated ..	273	
No. of cable pieces water penetrated ..	420	

It is to be regretted that the scheme of replacing the present aerial toll lines between Tokyo and Okayama (nearly 500 miles) by such quadded and loaded cables, with repeater stations *en route*, will have to be postponed; as a part of this scheme the cable working between Tokyo and Odawara was in course of construction. The cable drums had been distributed along the route, so that they sustained heavy damages; while the loading coils were burnt completely, for they were in course of testing in Yokohama. But it is desired to perform the above scheme as soon as the financial condition of the Government admits.

Cables Routed on Bridges: Figures 12 and 13 show examples of the damages done to the cables routed on public bridges in Tokyo, which were found at a point crossing the Government railway where underground cables were installed in conduits laid under the road. By the destruction of the embankments at both sides all conduits at points indicated by A and B in the figure and the lower layers of conduits at point C were broken; consequently cables kept their continuity merely by cores, lead sheath being peeled off as shown in Figure 15. This is caused by the shearing force on conduits, caused by the relative displacement between

the embankment and concrete wall. Such shearing or crushing occurred at places where soil and structures of different solidity meet together, for the wave motions in both were different.

Generally, in cases where cables were laid over public bridges or on special telephone cable bridges, it is a matter of course that these cables were burnt where the bridges were burnt, and even in case where the bridge itself escaped the fire, a majority of the cables were burnt by the conflagration of boats which crowded under the bridge for the purpose of getting shelter and escaping from the pouring flames and burnt ashes. In the case of concrete or stone bridges and special telephone cable bridges, which were far from the general public or not crowded by boats, cables were safe.

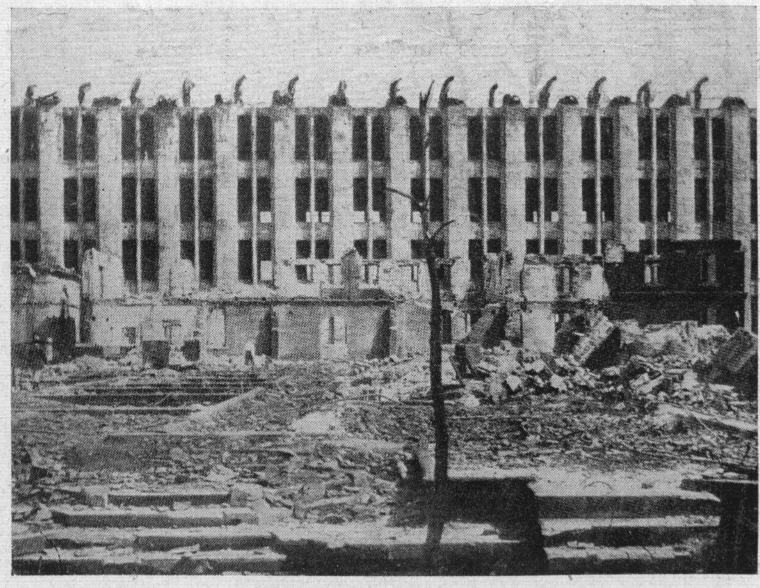


Figure 11.—New Tokyo Central Telegraph Office after Fire. In Course of Construction

Office Manholes: The office manholes were safe in centrals which escaped the fire, while in burnt centrals lead sheaths of cables were peeled off, leaving mere cores as entangled ropes. A majority of manholes placed in front of centrals were undamaged in appearance.

Cables in Lateral Tubes: In the burnt portion of the city a majority of cables in laterals were burnt and melted lead sheaths were stuck in the tube up to near the ground surface.

Manholes: In Tokyo the majority of the damages in manholes were cracks in its walls due to horizontal quake. In Yokohama there were many cases where only a part of the manhole body itself was shifted horizontally, leaving the cover case projecting above the ground surface by one foot or so owing to sinking of the surrounding earth; the entrance arch was damaged and cast-iron conduit projected by three feet or so towards inside of manholes. It is remarkable that there were no manholes which sank below the ground surface, and this is probably due to the fact that the foundation was somewhat better than the surrounding earth.

Equipment	*Centrals* Koishikawa	Takanawa	Ushigome
Switchboard ...	... Right	Slightly shifted	Right
M.D.F. and I.D.F.	... Slightly inclined	Slightly inclined	Right
Rack	... Inclined	Slightly inclined	Right
Register rack ...	... Right	Slightly inclined	Right
Battery—24 volt	... Right	Right	2 cells damaged
Battery—40 volt	... Right	1 cell broken	Some on upper shelf broken
Generating equipment	... Right	Right	Right

Equipment	*Centrals* Yotsuya	Kudan	Awoyama
Switchboard ...	... Line of surface shifted	Nearly the same as other Centrals—All equipments here were dismantled and added to other Centrals	Right
M.D.F. and I.D.F.	... Slightly inclined		Right
Rack	... Slightly bent		Right
Register rack ...	... Right		Right
Battery—24 volt	... 3 cells damaged		2 cells damaged
Battery—40 volt	... Some on upper shelf broken		Some on upper shelf broken
Generating equipment	... Right		Right

Underground Conduits Near Riverside: In the case of roads along the river bank the parts near the river became disturbed; consequently underground conduits and manholes became exposed and cables damaged.

Open Wires: Generally it seems that the damages done to the poles and open wires were most serious where the direction of the pole line coincided with that of the quake propagation.

Damages on toll lines were nearly the same as those of telegraph lines; the number of circuits damaged amounted to 303 terminating in Tokyo, and 111 terminating in Yokohama.

Emergency Measures: The following are the measures performed concerning telephones in consequence of the disaster:

(*a*) Local exchanges: In Tokyo, for Government offices pertaining to the temporary relief work and for other important subscribers, the service was opened by means of standard magneto switchboards, each of 100 subscribes' capacity, installed a room in the Tokyo central post office, which escaped the fire as referred to above; as a next step newspaper offices, banks and other subscribers having cl ose relation with public interest were added as soon as the line plant, instruments and materials admitted. In Yokohama, since no building belonging to the Department of Communications had surived, a standard magneto switchboard, with a capacity for 50 subscribers, was installed in the branch office of public works of the Department for Home Affairs; thus service was restored to governmental offices and important subscribers just as in Tokyo. Later this equipment was removed to the barracks in front of Sakuragicho railway station.

(*b*) Toll Lines: On September 3 the toll circuits to Sendai and Utsunomiya were opened at Senju like telegraph lines, and these were then cut over to the standard magneto switchboards for the toll line purposes, which were installed in the Tokyo central post office at the same time the circuits to Nagoya, Osaka and other important cities were restored. As, owing to the inherent function of the standard magneto switchboard, the toll service could not be given to the subscribers belonging to common battery offices, several pay stations were installed in the Tokyo central post office for the purpose of this service. Later, as the number of circuits increased, restriction for toll service was removed. Owing to shortage of the number of toll circuits, at first the toll service was afforded to messages relating to the relief business. On November 10 the total number of working circuits amounted to 74. Prior to this some modifications were given in order to give toll service to all subscribers in common battery offices.

In Yokohama, at first, the toll as well as telegraph service to Tokyo was opened in the waiting room of the Kanagawa station of the inter-urban electric railway between Tokyo and Yokohama, later removing it to the barracks above mentioned. The number of circuits to Osaka, Kobe, Nagoya and other important cities was nearly ten on November 11. As restoration of Yokohama was very slow, such number of circuits was sufficient for the toll service.

Damages Done to Radio Stations

The number of radio offices within the area of the disaster is given in the table below, 6 among 20 stations being damaged most seriously:

Administration	*Public*	*Private*	*Experimental*	*Total*
Dept. of Communications ..	0	0	3 (3)	3 (3)
Naval Department	2		1 (1)	3 (1)
Department of War	0	1	1	2
Department of Railways ..	0	0	1	1
Factory	0	0	4	4
School	0	0	4 (1)	4 (1)
Others	0	0	3 (1)	3 (1)
Grand Total				20 (6)

Figures in brackets denote totally damaged.

As seen in this table no station for public service was within the area of the disaster, but by means of installations in the military office and a few equipments which survived in the communication officers' training institution, immediate emergency measures were performed even before the severe shock hardly

slackened. Unfortunately the installation in that institution was reduced to ashes by fire early the next morning excepting two iron towers.

The burnt-out important offices which have relation with radio engineering are the electrical laboratory, Communication officers' training institution and naval technologic research section. As these possessed the most important laboratories and research equipments in Japan, the loss which our empire encountered is very great; for we have lost important research results, documents, reports, etc., together with equipments which were very important for the development of radio engineering, and also preparations for the coming conference on international radio communications.

It is reported that on September 1, in the Communication officers' training institution only a few minutes before the great quake, the resonance condition of the receiving apparatus was exceedingly deranged, when some measurements for the radio communication from North China were being investigated by the operator. Immediately after he had noticed this extraordinary phenomenon he felt the quake. Such a phenomenon might be caused sometimes by the swinging of the antenna, but the antenna in that institution was so tightly stretched that in ordinary heavy storms such a condition was never observed before. It is improbable that the operator was too earnest in inspection not to take notice of the first shock of the quake, because he felt the quake at the same time the others did. The quake in far distance might probably be mentioned as a cause for the above phenomenon, but the exact interval of time which elapsed between the first quake and the feeling of that phenomenon was not observed; so this phenomenon is cited as an instance toward solving the question to be met in the future. It may be added here that in that institution after the quake listening was continued till early next morning, when that building was burnt.

Soon after the fire a temporary circuit between the temporary Tokyo central telegraph office and the telegraph corps at Nakano was established; so that by means of the radio installation at the latter place, communication was begun to all coast stations from Tokyo. It is said that in this performance in the telegraph corps portable radio apparatus proved a great success.

After September 2, as communication between warships, which were anchored at Yokohama or Shibaura (in Tokyo), and land stations increased, their interference in Tokyo bay became fairly strong. Beside the above, Funabashi station was successfully used for service. The newtwork of radio communications for the public after the disaster is shown in Figure 19 schematically.

While the above is a general description of the measures which were taken in the environs of the Tokyo central telegraph office, many of the radio stations in local districts took an active part in the communication service. The news of the great disaster of September 1 was received in Hongkong and Manila on that day via Osezaki, which was sent from Choshi and Iwagi, and on the other hand reports were sent from Iwagi direct to the United States of America and Hawaii, so that all the ships at sea listened in to these messages. Furthermore, the Iwagi station continued to send reports to America telling the conditions of Japan and translating news successively. This station contributed to a great extent in arousing in America and Europe profound sympathy for Japan; it is especially rejoicing to note that the master and the officers of Iwagi station were publicly recognized in America. It must be mentioned here that the ship station on board the *Korea Maru* and *Mishi Maru*, which lay anchored at Yokohama, served to communicate with every quarter of the empire, day and night, on and after September 1; also all the coast stations endeavored to serve in a state of sleepless and unresting condition for a fortnight. It is also reported that the Ohi factory, belonging to the Department of Railways, and being one of the experimental stations, served to communicate with ferry-boats that ran between Tokyo and Shimizu.

The great difficulty encountered in connection with radio communication was confusion, as stated above, but this was restricted to the Tokyo bay, and by order it was practically overcome by means of proper adjustment of the wave lengths.

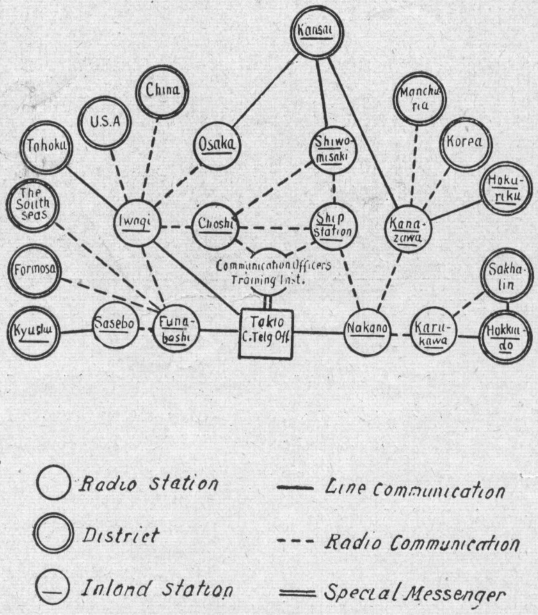


Figure 10.—Schematic Radio Communications After the Disaster

Other Damage Done

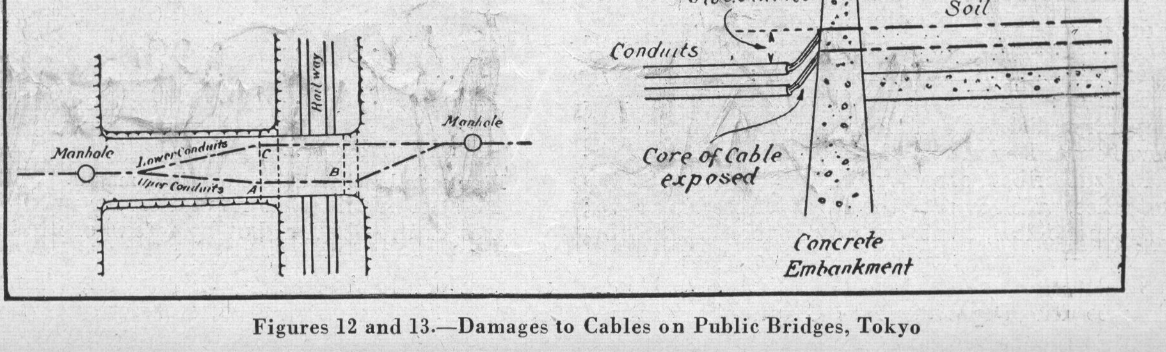
Material or immaterial losses beside those previously mentioned were sustained from damages occasioned to the buildings of the Department of Communications, electrical laboratory and technical section of the Tokyo administrative office, as well as store-houses which were completely burnt. In these three offices above mentioned were located very important laboratory installations, containing therein reports of research, documents and materials for investigations relating to wired and wireless telegraphy and telephony in Japan which had been prepared by many engineers, who spent many years, some in foreign countries, gathering valuable reports and papers, and others at home working most painstakingly at their chosen profession. It is to be greatly regretted that these precious documents and installations were reduced to ashes and that nothing can compensate for the loss, which cannot be estimated in terms of monetary value.

The disaster caused not only much inconvenience in the preparation of papers for the technical committee on international radio communications, but also it introduced great obstructions for the telegraph and telephone extension plants to be performed in future, which are being proceeded with upon a plan laid out for a number of consecutive years.

While much stock material was in store for emergency purposes, much of it was lost by the conflagration, causing great obstructions to emergency measures. On the other hand, much difficulty was encountered as the more important business and factory quarters of the city were wiped out.

A few instances regarding information about telegraph and telephone installations will be added below, as such results of investigation of the damages caused are of some value toward preventing such disasters in future.

Office Buildings: It would be very important as well as interesting to architects to investigate the condition of buildings which escaped the damages of the quake and came comparatively unharmed through the fire. Quake and fire-proof structures are to be recommended for houses in all



Figures 12 and 13.—Damages to Cables on Public Bridges, Tokyo

Ushigome Telephone Exchange Building in Tokyo which was not destroyed by the quake or fire and is one of the Most Modern Central Offices in the Capital

the important parts of the city, especially for telegraph and telephone offices. Telegraph and telephone installations are urgently required in times of such disasters, and much thought should be given to selection of proper types to be adopted for these buildings. While most of the brick structures became dangerously shaken by the earthquake, reinforced concrete buildings were immune to both the earthquake and fire. In Tokyo, for instance, the building of the toll and two local exchanges at Marunouchi was destroyed by the fire with all the contents except mere structures, so that the building is being refitted for the purposes of establishing a temporary toll exchange, and housing the Tokyo central telegraph office and one of the local exchanges. Beside this, the buildings of the centrals Ginza, Asakusa, Hamacho, Horidome and Sumida may also be utilized again by simply repairing the inside fittings. From the above it is evident that reinforced concrete building should be adopted in all cases in future.

By the first shock of the quake all water mains were interrupted, so that fires at almost every part of Tokyo and also of Yokohama got immediate headway at their will and nearly all important parts of Tokyo and the whole of Yokohama were turned into ashes. Temperature of the burning areas reached such high degree that window and other glass and some metal parts melted as if in hearths, and it is also to be noted that metal fire-shutters in all the buildings worked ineffectively. In future much precaution must be taken in fireproofing windows, which seem to be the weakest point of buildings. Strong cyclones and high winds were caused by local temperature differences during the fires. Some pepole were blown upwards and carried to places some distance away. It is difficult to say what unexpected events happened during those few days. It is needless to say that all such questions must be taken into consideration by engineers who are to shoulder the responsible work of reconstruction and all measures for fire and quake proofing should undoubtedly be provided for.

Construction of Lines : In the burnt up areas the overhead telephone lines were completely destroyed by fire, though a majority of them were replaced by underground system long since. These overhead lines being for distribution purpose for subscribers, it is desirable to replace them by an underground system, if financial conditions will permit this to be done in the near future. As given in a table previously referred to, damages to the underground cables were rather slight, much less when compared with aerial lines, even in the cases where manholes became flooded by water, or cast-iron conduits projected into the manholes due to destruction of road and crushing of conduit. From the point of view of beauty, and also for reasons of frequent faults in aerial lines, it would be advisable to put the whole system undergrounf in both Tokyo and Yokohama.

Construction of Underground Lines : A majority of manholes were flooded by drais due to loosened connections and breakages of conduits. In future special attention should be paid to workmanship of jointing the conduits and uniformity of foundation beds along the entire underground construction.

River Crossing : For routing cables over public bridges it is safer to choose bridges of fireproof construction, such as concrete or stone work, and to wrap them with some fireproof material. It is preferable to wrap cables with fireproof substance even where special telephone cable bridges are used, or to install them under the river bed. In the late disaster some cables, which were otherwise undamaged, were damaged at river crossings, which caused delay in re-opening the telephone service to some extent. It would be very interesting as well as instructive to investigate methods of river crossing of cables.

Supply of Equipments and Materials : The most difficult problem encountered in making arrangements for emergency measures was the requisition of instruments and materials. Stocks of instruments and materials, which were lost by the disaster, amounted to an enormous quantity, and because many of the factories were also damaged, their supply was obtained partly from local makers, while some was imported.

Adoption of Automatic Telephone System : It is true that civilization tends to replace the manual power by the mechanical.

Shiba Telephone Exchange, One of Four Central Offices in Tokyo spared by the earthquake and fire

Aoyama Telephone Exchange in Tokyo, one of four surviving the quake and fire

Though it is also clear that, in case of telephone service, to use a great many operators is both uneconomical and incovenient, owing to financial reasons the adoption of the machine switching system has not yet been realized. It is firmly believed that this is the best opportunity to replace the former inconvenient telephone by a more up-to-date and convenient automatic system, as both Tokyo and Yokohama are now deprived of the telephone service almost entirely.

Installation of Radio Telegraph and Telephone: At the time of the late disaster there were no public radio stations in the burnt-up area which catered to the public service, and consequently no radio station was damaged; but if there had existed an undamaged one we can easily imagine its possible activity. It would have been a foregone requirement that an uninterrupted supply of electric power and a continuous communication between it and the central office were firmly established.

It is to be noted that in the last disaster the entire system of the electric power supply and lighting were interrupted for some time. From these observations it is evident that such installations should be made fire and quake proof, and that inter-connections between power houses and transformer stations, between these points and consumers, etc., should be of the underground system.

Broadcasting of radio telegraph served admirably in reporting the disaster to foreign countries as well as to ships at sea. It is firmly believed that telephone broadcasting would have played an efficient part if it had existed, a good reason for its realization.

Store-houses: It is believed that store-houses in future should be not only as rigid in construction as other buildings (or rather more so), but also fireproof, as much difficulty was experienced in executing emergency measures at this time. It is safer not to centralize store-houses, but to distribute them in many quarters of the city, in spite of some inconveniences to be felt in ordinary days from the point of view of storing, shipment and supervision. In the late disaster, for instance, the storehouse at Shibaura remained undamaged, while that in the enclosure of the Department of Communications was burnt. It is worth while to consider this problem.

Outline of the Program of Reconstruction Executed and Otherwise (March 1, 1924)

Telegraph

Tokyo: As a consequence of the removal of restrictions for messages, as above mentioned, the volume of traffic increased tremendously. The number of circuits was increased to 76 in Eiraku building, which was the full capacity of that temporary office. On November 23 this temporary office was removed to the repaired building in which the local telephone exchange Marunouchi was located. At that time some suburban circuits were added. The traffic-carrying capacity of the circuits has been restored since December 12 to that of as nearly as before the disaster, being increased by 160; while some circuits for city branch offices could not be restored owing to the delay in reconstruction of buildings. At the end of the year 1923 circuits were classified as follows:

System	*Number of Circuits*
Automatic duplex	24
Sounder duplex	58
Sounder simplex	144
Morse duplex	3
Morse simplex	14
Siphon recorder simplex	1
Telephone	1
Total	245

With the addition of 11 circuits in January 1924 nearly all circuits were restored to their former capacity with the exception of local circuits in the city. These city circuits will be opened as soon as switchboard and other equipments as well as office accommodations are ready.

As far as the number of circuits is concerned, restoration will be accomplished by April 1924,* while complete reconstruction will be finished early in the year 1925. At that time the Tokyo central telegraph office will be removed to its new building, which was in course of construction before the disaster.

The pneumatic tubes in Tokyo had been installed between the Tokyo central telegraph office and eight branch offices with a route mileage of nearly 6. But all the terminals were destroyed by fire and the underground tubes damaged also. The present scheme of reconstruction is to connect the first four branch offices with the central when the permanent office is opened, making a route mileage of 3.5. Successively for 13 branch offices a mileage of 20 in the year 1925, and for four branch offices a mileage of 8.5 in the year 1926, will be added, connecting with the central office respectively.

Yokohama: As previously described, 19 circuits were restored by the emergency measures in the temporary office at Sakuragicho, while at the end of November these were increased to 26. 39 circuits were totally restored in the first part of January 1924, the office being removed to the new building. These circuits may be classified as follows:

System	*Number of Circuits*
Automatic duplex	1
Sounder duplex	8
Sounder simplex	28
Morse simplex	2
Total	39

Complete restoration will be accomplished in April 1924.

Telephone

Tokyo. (*a*) Exchange: Prior to the disaster, in Tokyo there were one toll and 19 local exchanges, serving about 83,000 telephone stations. Among them the toll, 15 local exchanges and nearly 52,000 stations were burnt or wrecked by the disaster. An area of 13.5 square miles in the city of Tokyo was burnt to the ground, 30.5 square miles being the total area. The remaining centrals were re-opened on September 29, after urgent repairs to office equipment and line plant. The number of stations in those four centrals are given below:

NUMBER OF STATIONS

Central	*Before Disaster*	*Burnt or Wrecked*	*Opened on Sept.* 29
Awoyama	2,416	0	2,416
Koishikawa	6,836	699	6,137
Ushigome	4,172	0	4,172
Takanawa	4,473	125	4,348
Total	17,897	824	17,073

Since the localities which are covered by the above centrals are situated on more or less hard bed ground, damages to them were comparatively slight.

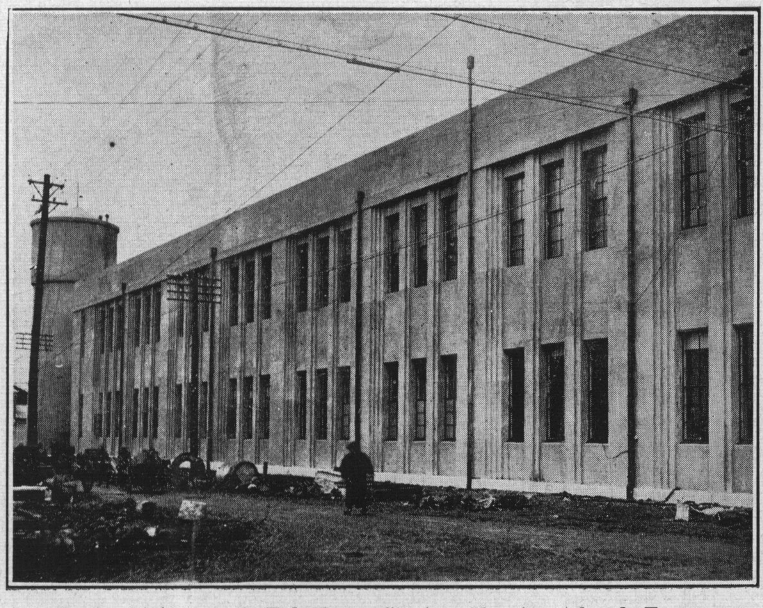
It is of interest to give a brief description about the traffic data on telephone service during the first three days after re-opening the four centrals. The average number of calls per station per day was 2.5, while 8.5 was the average during last August, just before the disaster.

Immediately after the above centrals were re-opened efforts were made to connect those subscribers who were most urgently in need of telephone service and who were scattered over all quarters of the city, to any one of the above four centrals according to their locations, by the aid of inter-office trunk lines. Thus a total of 20,743 stations were restored by the end of the year 1923. The temporary local exchange Ote was opened with a capacity of 4,000 in the burnt building of central Marunouchi. By the end of March the central Yotsuya will be re-opened, after repairs to that building are accomplished. Thus a total of 30,000 stations will be restored. By the extension of the switchboards in the above six offices, 9,000 stations will be added by the end of August.

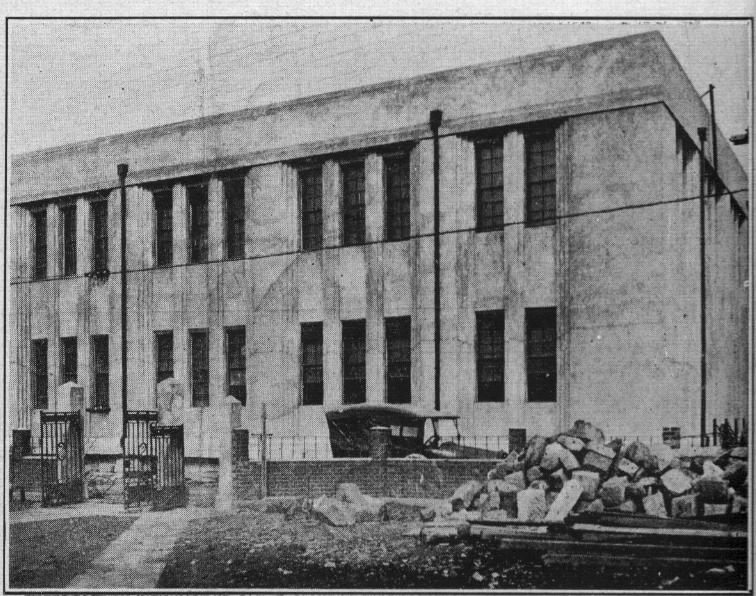
Two of the four burnt offices, the buildings of which are in course of repair, will be re-opened in the fall of 1924, and the other two by February 1925, the common battery system being employed. By March 1925 the total sum of stations restored will be enumerated by 64,100, there being 83,000 before the disaster.

Besides the total of ten exchanges, thus restored, four and five automatic exchanges will be opened by the end of the fiscal year 1924

*Dates appearing in this article are published without change. Attention is called to the fact that the program of reconstruction is dated March 1, 1924



Kyobashi Automatic Telephone Station, Showing Adosole Tower



Honjo Automatic Telephone Station

and 1925 respectively, one of them being planned to supplant the temporary common battery office Ote. Restoring of the remaining 19,000 stations in Tokyo will be accomplished at the same time.

The program of measures for telephone reconstruction is expected to extend for a period of $2\frac{1}{2}$ years, rather longer than usually accepted. In justification to the length of the reconstruction period it might be mentioned as follows. It is, of course, true that restoration of telephone service should be done as quickly as possible, as it is one of the most essential for the reconstruction of Tokyo. On the other hand, it may easily be justified that the work of reconstruction of the multi-office telephone area, which has stations numbering more than 80,000, cannot be treated as simply as the case of several independent telephone areas of moderate capacity. For the preparation of switchboards, first of all, a great difficulty is encountered. As several of the factories for telephone industry were damaged it must be expected that a rather longer delivery for home made is inevitable. Many foreign makers also offered earnest suggestions for the restoration of the telephone system, but they could not supply switchboards of the specified type at the specified time of delivery. To adopt many different systems of switchboards in the present case in Tokyo must be carefully considered, from the point of view of inconvenience and want of economy in operation and maintenance.

On the other hand, security of service cannot be expected if telephone offices were installed in imperfect buildings like barracks. Moreover, owing to probable alterations in the street contours, as a consequence of the city's reconstruction planning, construction of permanent buildings is not allowed before that plan is settled. To build offices with risk of removal within two or three years cannot be thought of. It is thought not unlikely that a tot l of 30,000 stations can be restored by March 1924, and 64,000 by March 1925. With this number it is expected that a restoration of service to all subscribers, at least one substitution for each subscriber, and also a fairly ample service may be given in Tokyo, the condition of general business being depressed to some extent compared with that before the disaster. A careful investigation regarding every point leads to the conclusion to adopt the program of telephone reconstruction outlined as above.

(*b*) Toll Line: After the emergency measures, as previously mentioned, were taken on December 1, 1923, the temporary toll office was removed to the repaired building of the old Marunouchi, where equipments were provided for 164 circuits. The number of toll lines will be increased to 277 by the end of March 1924, and it will not be so long before all circuits, 317, will be restored; while in the fall of 1925 the permanent toll exchange will be opened.

Yokohama. (*a*) Local Exchange: While there were in Yokohama one toll and two local exchanges, serving 10,600 stations, the whole was practically destroyed. On September 29, 1923, 30 subscribers were restored, and this increased to 450 by the end of that year. It is planned to restore 2,000 stations in the new temporary office by March 1924, the switchboard being of the magneto parallel multiple type removed from a central which was recently closed in Tokyo; by June 1924 the sum of stations will increase to 3,700. In the fall of 1925 two automatic exchanges will be opened, where all the subscribers will be cut over and all the remaining stations will be restored at the same time.

(*b*) Toll Line: The number of toll lines in Yokohama before the disaster was 111. Gradually increasing the number of lines restored, a total of 35 were completed at the end of the year 1923. The sum of restored lines will become 73 by the end of 1924 and 111 by 1925, thus making all restored.

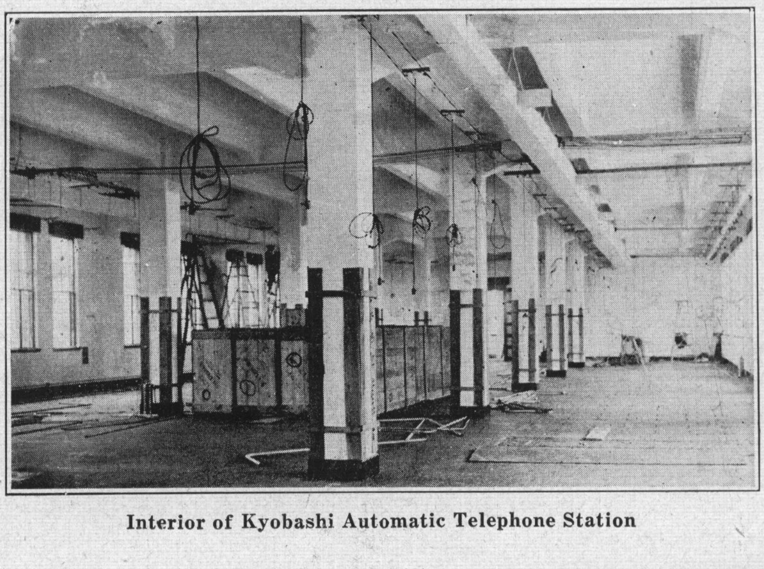
It must be added that when the automatic system supplants the manual local exchange the permanent toll office will be opened.

Restoration of Telephone Services in Tokyo and Yokohama.

In consequence of the earthquake disaster on September 1, 1923, the telephone plants in both cities were so badly wrecked that service to the 84,000 subscribers in Tokyo, 10,600 in Yokohama, and toll service on 429 circuits were shut down.

Emergency repairs were started immediately on the central office equipment and line plant of the four offices not destroyed in Tokyo, namely, Aoyama, Takanawa, Koishikawa, and Ushigome. This work was completed as soon after the disaster as September 29, and the four offices reopened on that date. Subscribers were restored day by day, so that, by the end of the year, the total number reached 20,743.

Common battery switchboards were installed on an emergency basis in the badly-



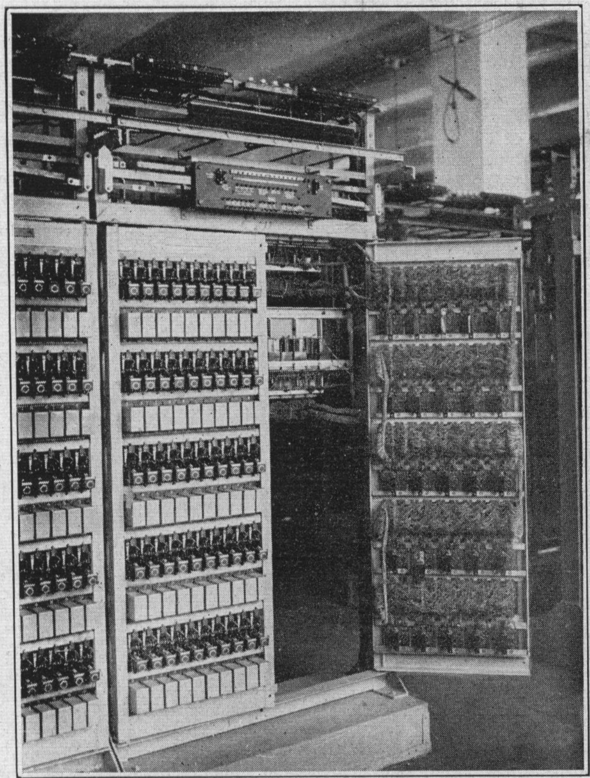
Interior of Kyobashi Automatic Telephone Station

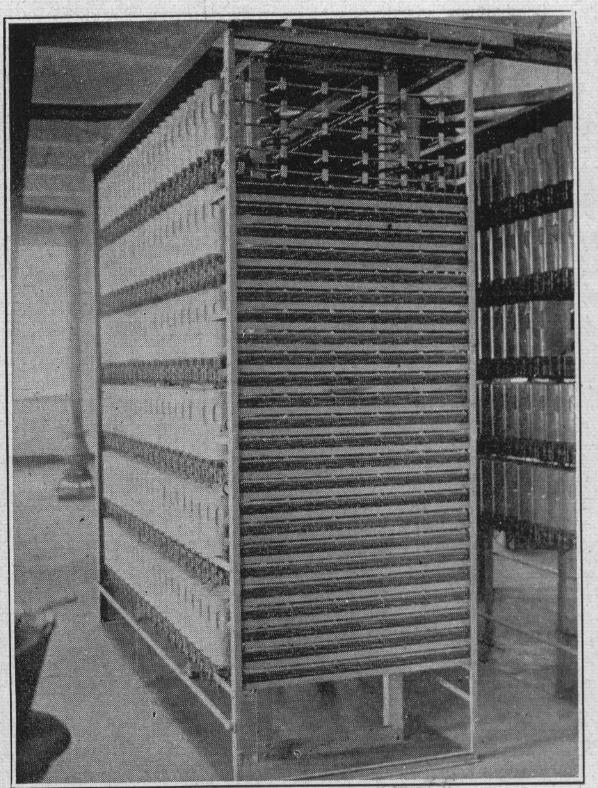
damaged Marunouchi and Yotsuya centrals. These two offices were put in service shortly after the first of the year, the former being opened under the new name of Ote. This permitted a total of about 30,000 subscribers to be restored in Tokyo by March 1, 1924.

In Yokohama, temporary central office equipment was installed in the repeater station which was under construction at the time of the earthquake, and service restored to 2,000 subscribers.

Temporary service toll switchboards were installed in the Ote office, Tokyo, and a standard toll board in the temporary station in Yokohama, with the result that toll service was resumed over 164 circuits.

The restoration work proceeded under the plan adopted of restoring all remaining subscribers during the two fiscal years 1924 and 1925 and of completing during 1925 such rearrangements as will be necessary to bring the two exchanges to a permanent basis that will assure satisfactory and economical service. By the end of March 1925 the following results were obtained:





Honjo Automatic Telephone Station

Front View of Line Switch Board

Side View of the Selector Board

A—Tokyo

Centrals	*No. of restored Subscribers*
Koishikawa	7,267
Aoyama	6,598
Ushigome	6,249
Yotsuya	6,187
Takanawa	7,176
Ote	6,420
Asakusa	7,613
Ginza	7,233
Naniwa	6,384
Sumida	5,459
Total	66,586

B—Yokohama.

No. of restored subscribers, 4,260.

C—Toll Lines.

Total number of restored circuits in Tokyo and Yokohama—351.

From the above it is seen that at the end of the fiscal year 1924 the damaged telephone plant had been restored to a point where the number of subscribers in service was in Tokyo 80 per cent. and in Yokohama 40 per cent. of the number before the disaster, and that 82 per cent. of the toll lines were restored.

Programme for Restoration is the Next Step.

The plan for further telephone restoration is as follows:

A. Tokyo.—During the fiscal year 1925 the five centrals, Kyobashi, Kanda, Honjo, Shitaya and Kayabacho, will be re-opened with A.T.M. Co.'s Automatic equipment. The completion of these offices will permit the remaining 16,500 subscribers to be restored to service, and in addition a total of 12,274 subscribers located temporarily in manual offices will be cut over to the automatic offices. The greater part of the switchboards for the new offices have arrived; the new buildings will be completed in the near future, and it is expected that they can be opened in accordance with the following schedule:

Centrals	*Date*
Kyobashi	Jan. 1926
Honjo	,, ,,
Kayabacho	Feb. ,,
Shitaya	March ,,
Kanda	,, ,,

It is further planned that during the fiscal year 1926 four other central offices, Kudan, Nihonbashi, Marunouchi and Shiba, all equipped with automatic apparatus, will be opened, and a total of 12,162 existing subscribers located temporarily in other centrals will then be cut over to them. All of the subscribers served from the temporary Ote office will be included in those transferred to the automatic offices and Ote will be closed. As a final result of the restoration the figures will accordingly be: Nine manual exchanges serving a total of 46,737 subscribers; nine auto-exchanges serving a total of 37,263 subscribers. It is expected that the number of subscribers served by each automatic office at the end of the fiscal years 1925 and 1926 will be as follows:

Fiscal year 1925.

Centrals	*No. of Subscribers*
Kyobashi	6,068
Honjo	5,676
Kayabacho	2,919
Shitaya	5,832
Kudan	3,499
Total	25,101

Fiscal year 1926.

Centrals	*No. of Subscribers.*
Kudan	3,515
Shiba	2,524
Marunouchi	2,373
Nihonbashi	3,631
Total	12,162

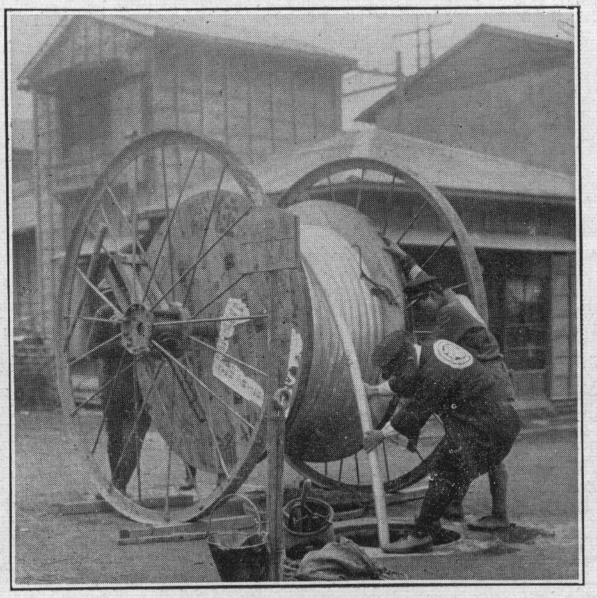
B. Yokohama.—It is expected that two offices, Honkyoku and Chojamachi, will be opened in March 1926 with Siemens and Halske automatic equipment. The completion of these offices will provide for restoring service to 6,340 subscribers, and in addition the 4,260 subscribers which have been served from the temporary office will be cut over to these new offices, the temporary office being closed.

C. Toll Lines.—In Tokyo the 40 remaining toll lines will be restored to service during 1925. It is expected that a new B.C. toll board will be completed during 1926 and all toll lines will be cut over to it.

In Yokohama a new common battery toll board will be opened during the fiscal year 1925. All operating toll lines will be cut over to it and service will also be restored on the 38 lines remaining out of service until that time.

Extension of Cable Plant.

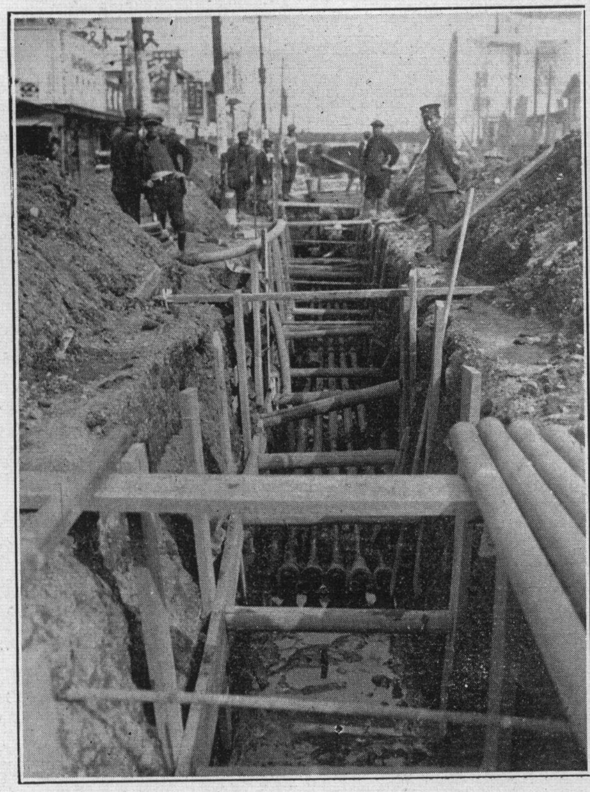
Before the earthquake the area of the streets in the cities of Tokyo and Yokohama was only about 12 per cent. of the total area as compared with 20 per cent. in many of the cities of other countries. For years the necessity of widening the streets has been considered most urgent. The reconstruction of the cities at this time offers a chance to care for this necessity by changing the street contours and widening and improving the road surfaces. Such changes in streets will involve extensive changes in the Government-owned telephone and telegraph line plant.

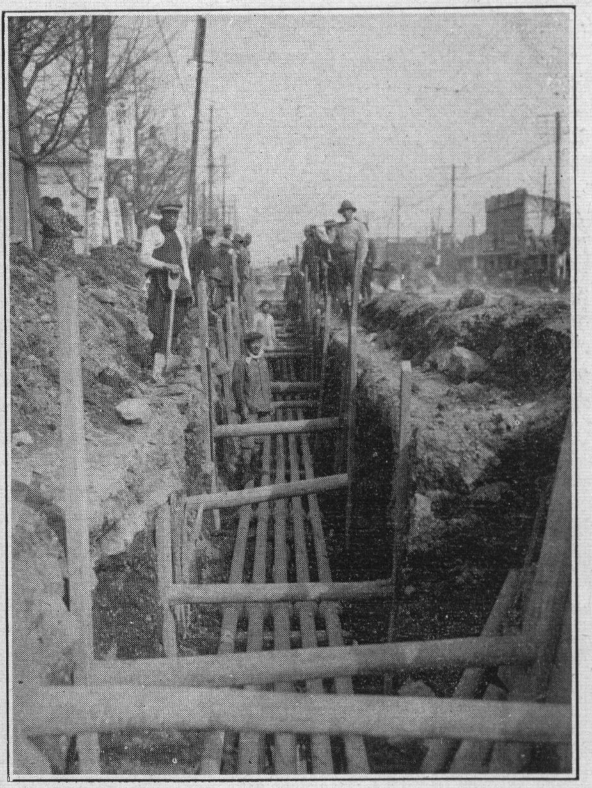


Drawing Cable into Ducts

In carrying out these changes it is essential that provision be made in the underground plant to care for future development as determined by fundamental plan studies. In this way the cost of the plant over a period of years is kept to a minimum, and also the repeated digging up of the streets, with the consequent blocking of traffic, is avoided as far as possible.

As a safeguard in the future against damages such as were experienced in the recent disaster it is planned to use, in the main parts of the cities, fire and earthquake-proof buildings which will greatly improve the cities' appearance. Consistent with these plans it will be desirable to abolish as far as possible the use of aerial wire distribution by placing the wires underground. For example, in a location such as the Marunouchi district the distributing plant should be entirely underground and aerial distribution completely done away with. Aerial toll entrance lines should be completely replaced by underground cable, thus avoiding interruptions to toll service which now frequently occur, due to the necessity of removing pole lines to care for the development of suburbs.





Laying Telephone Cable Ducts Under Street

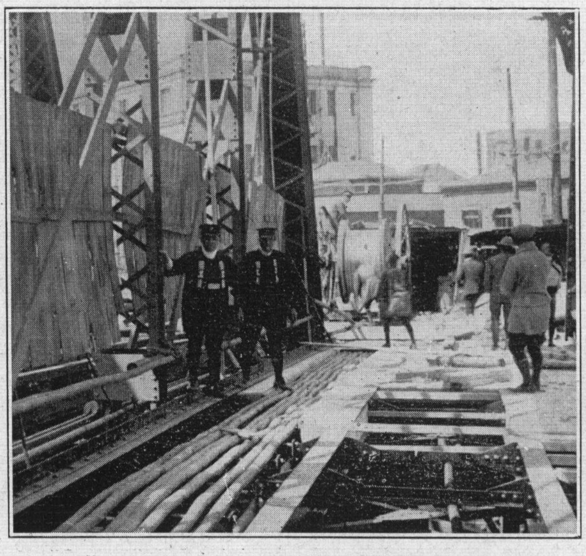
Adoption of Automatic Exchange System.

Technically and economically the automatic telephone system has proved itself successful. Before the disaster difficulty was being experienced in the larger cities in securing and training operators for the manual switchboards. In Tokyo it was estimated that about 10,000 operators would shortly be required, and it was expected that so large a force would be extremely difficult to maintain. The automatic system was being studied in Japan as a means of relieving this situation and as an improvement in telephone service. A small experimental installation was in operation in the Department of Communications.

In a large multi-office exchange area such as Tokyo it would, of course, have been impracticable to replace all the manual offices with automatic equipment at one time, due to the extremely high first cost of the automatic equipment and the great loss involved in abandoning the manual switchboards before they neared the end of their useful life.

The principal objection to the introduction of automatic equipment, one office at a time, in such an area is the high cost of arranging all the manual switchboards for interchanging calls with the relatively few subscribers served from the automatic equipment.

In considering the type of equipment to be used for restoring the plant destroyed by the earthquake disaster the above objections to automatic equipment have disappeared, while all the advantages remained. There was, of course, no question but that it would be more economical to install automatic at once than to restore the plant on a manual basis and later replace it with automatic equipment in order to meet satisfactorily the public requirement for service improvement or because of economic necessity.



Cable Laying Over Bridge

The quantity of telephone material required for the reconstruction work was so large that most of it could not be obtained in Japan, regardless of the type decided upon. In view of all these favorable factors it was decided to proceed with the permanent restoration on an automatic basis.

Trunking Scheme in Tokyo.

As stated above, nine manual offices will remain in service after the

completion of the restoration program, and it will accordingly be impracticable to place the entire Tokyo exchange on an automatic basis at once. Call indicator switchboards will be installed for completing calls originating in automatic offices for manual office subscribers. The method of operating these switchboards is considerably different from any now in service in this country, and careful attention must be given to the proper training of call indicator operators in order to insure high-grade service.

With the numbering scheme adopted, each subscriber's number will consist of six digits, the first two being used as an office name or designation, and the last four being the subscriber's number. The Tokyo exchange area is divided into seven districts. When the reconstruction work is finished there will be from two to four offices in each district. However, this number will, of course, increase as the exchange grows. The following table gives the details of the district and office numbering scheme.

District and Office Numbering Scheme.

Offices	*District Numbers*	*Office Numbers*
Marunouchi	—	3
Nihonbashi	2	4
Kanda	—	5
Kudan	—	3
Ushigome	—	4
Yotsuya	3	5
Aoyama	—	6
Shiba	—	3
Takanawa	4	4
Kyobashi	—	6
Ginza	5	7
Kayabacho	—	6
Naniwa	6	7
Honjo	—	3
Sumida	7	4
Shitaya	—	3
Asakusa	8	4
Koishikawa	—	5

The digit being omitted on account of liability of sending false impulse, the digits from 2 to 9 are applied for both district and office numbers. As the final capacity of an automatic exchange is 10,000 lines, it is not necessary to change this 6 digit system until subscriber lines increase up to about 800,000 in Tokyo.

Total Expenses for Restoration.

The total expenses required for restoration of telephone equipments amount to the enormous sum of 102 million yen, of which 12 million yen was invested in the emergency repairs just after the disaster and 90 million yen is divided for the years 1924, 1925 and 1926 as follows:

1924.	1925	1926	Total
thousand yen		thousand yen	
34,101	36,652	19,247	90,000

The principal reason of such an extraordinarily large sum as shown in the above table is to have to restore many subscribers temporarily in other existing exchanges and afterwards to cut them over to their own exchanges opened with automatic system. And otherwise it is also due to the restoration scheme laid out not only for recovering into original state, but also for future development.

Conversion of P. B. X. from Manual to Automatic.

The adoption of automatic equipment for telephone exchanges in Tokyo and Yokohama, which is an epoch-making step in the development of the telephone service in Japan, has attracted the attention of large P.B.X. users to this type of equipment. In Tokyo and Yokohama, and also in Osaka and other large cities, many large firms are considering the adoption of automatic P.B.X.'s as a means of improving their service from the standpoint of speed, privacy and accuracy. In many instances it is also expected that, even though the initial cost is high, the installation of automatic P.B.X. equipment will prove economical.

Some of the larger P.B.X. users have already placed orders for automatic equipments to replace the manual boards now in use.

"Adosole" Dessicating Plants.

Automatic telephone equipment comprises many small and delicate parts, many of which must be electrically insulated from each other, and it is essential that this insulation be maintained at all times. Special attention must be given this point, particularly where high humidity conditions prevail as in this country.

"Adosole" dessicating plants, which are inventions of the Physical and Chemical Research Institute of Tokyo, will be installed at each automatic office in Tokyo. These plants are used not only to keep the air dry in the equipment rooms, but also for cooling or heating the building.

The principal elements of an "Adosole" plant are as follows: "Adosole" tower holding ten tons of "Adosole" refresher, air blower, air cooler, air dryer, and dry air supply pipes. The plants are designed to give the following control in the building:

(*a*) With the temperature of the open air at 95°F, the temperature of the air in the test and switch rooms is kept below 85°F at a relative humidity between 60 and 70 per cent.

(*b*) With the open air at 20°F the temperature of the test and switch rooms will be maintained at 60°F.

(*c*) During the rainy season, with the relative humidity of open air at 90 per cent., the relative humidity of the test and switch rooms is kept between 60 and 70 per cent. by lowering the temperature.

Lessons Learned from the Disaster.

Most brick manholes were seriously damaged by the earthquake and it is believed that concrete construction should be adopted.

In localities where the soil bed is soft special attention should be given to providing suitable foundations for underground conduits.

Where possible, conduit routes should not be on riverside roads. Where conduits must be placed in such roads they should be located on the side of the road away from the river.

Since wood poles are liable to be burned, and because their life is relatively short, fabricated iron poles of simple triangular section will be adopted.

Radio Telephones for Japanese Ports

While radio broadcasting has been attracting such unprecedented attention in Tokyo, other parts of Japan have been making strides in the same direction, it is indicated by the announcement that the Port of Kobe is to facilitate communications between the harbor and vessels at sea by connecting the radio on board the ships with the telephone service in the port . The wireless telephone service will be used by Kobe residents to call up their friends at sea, or to broadcast programs to vessels in the harbor. In stormy weather the port of Kobe will inform ships at sea of their position and give other advice relating to the weather and the ocean currents.

The Department of Communications plans to establish a similar service at each of the large ports.

The original apparatus installed for this purpose at the port five years ago was a temporary machine and had a number of defects in operation. To make the service more satisfactory the Municipality has been constructing two towers, one on the roof of the Motocho office and the other in the compound of the central post-office. Better equipment is being installed to allow the service to expand.

The new plant will be in operation in August, when it is expected to be able to talk not only with vessels at sea, but with individuals in Akashi City to the west and those in Osaka and Kyoto in the east. The service will be expanded even to vessels passing through the Kwannon Straits and to those passing off the shore of Tosa, in the south-western province of Shikoku.

The primary function of the wireless service will be to determine the actual hour of the arrival of incoming vessels at port. The system was established at the request of the shipowners and business firms who have large importing and exporting transactions. The number of vessels who have entered into harmony with the organization of the new service now totals 1,215.

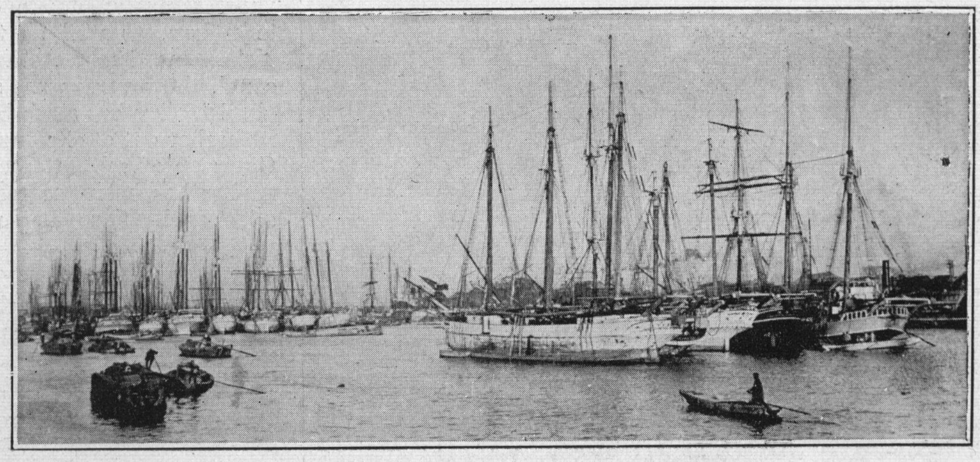
Befor the impending improvements the wireless communication service transmitted no less than 120,000 communications from shore to sea during the past year. Only 68 vessels had joined the service last June, and the number has grown steadily since. It is expected to exceed its present total as soon as the improved service, including radio transmission, becomes available.

The Key to Tokyo's Future Prosperity

The Harbor Extension and Tokyo-Yokohama Canal Plans

IN less than twenty-five years the entire Tokyo Bay foreshore from Yokohama to the Sumida, and from there to the mouth of the Arakawa Flood Prevention Canal, will be one continuous stretch of improved harbor. Docks, wharves, warehouses, factories and other improvements erected on reclaimed ground, protected by breakwaters and connected by deep-water canals, will as completely change the present aspect of the shore line as the opening of Yokohama to foreign trade has transformed in fifty years a salt-water marsh into the premier port of Japan. As we piece together the various schemes for the extension of Tokyo's harbor facilities and fit them in with the plans of the Tokyo Bay Reclamation Company at Tsurumi, where they merge with those of the Yokohama Harbor Board, it is not difficult to visualize the realization of the above picture. When we consider that the plans for building and expanding the present metropolis into a Greater Tokyo are based on an estimated population of seven millions, whose necessities of life must be brought from other parts of the empire by water, and that the costs of living will be largely determined by the cost of delivering these products at the water entrance to Tokyo, it requires no undue prescience to predict that the picture will come true.

It must come true, or the future expension of the capital will be checked and its prospects of developing into an industrial center effectively killed by exorbitant transportation, landing, lighterage, wharfage and warehouse charges on all necessities of life, merchandise and raw products. With a population increasing at the rate of 700,000 a year and pressing into the cities to seek a livelihood that is no longer possible to gain in the country, every facility must be provided by the authorities to meet this increasing demand for employment and keep down the costs of living. One of the greatest factors in this struggle for existence which confronts the people of Japan will be their ability to lower the present exorbitant scale of prices in the metropolitan district by reducing to a minimum the charges on all raw materials that will enable them in part to successfully compete with other nations in the markets of the world for the sale of their manufactured products. If this cannot be done, industry will move away from Tokyo and seek locations where these deep-water facilities are obtainable. This is just what is happening to-day in the Tsurumi and Kawasaki districts nearer to Yokohama.



THE SUMIDA RIVER AT TSUKISHIMA.
The Necessities of Life for the Metropolis are carried from all parts of the Empire on Small Coasting Vessels Discharging their Cargoes along the Sumida River Waterfront

That this truth is fully realized by those who direct the destinies of the city is seen in the many schemes put forward from time to time to improve and expand the harbor facilities. Like all other vast public improvements that interfere with or abolish ancient privileges and vested rights, every attempt so far to lighten the burden on the city of Tokyo has been met with the stubborn resistance of those interests which have waxed powerful and grown rich from the transportation tolls levied on practically every article entering the capital. The rise of Tokyo to the position of even a second-rate coastwise port permitting the entrance of 4,000 to 5,000-ton ships will deprive Yokohama of the large, fat and juicy squeeze now levied on all merchandise entering Tokyo from the sea and the still more handsome profits from lighterage charges which average more than the steamer freights from foreign countries. No city so situated can hope to escape from paying tribute unless drastic action be taken to free itself through the creation of modern harbor facilities, or in the event this is not immediately practicable, then all lighterage transportation should be taken over by the city and operated for the benefit of the people.

Tokyo to-day is by far the most expensive city in the world to live in. People pay more and get less for their money than in America, the land of high prices and standards of living. All this is traceable to the archaic conditions surrounding the transportation, landing, marketing and distributing system and the consequent heavy charges levied on all necessities of life. There may be a way to ameliorate this situation, but it would seem to the outsider that either the authorities must develop the harbor so that the largest coastwise steamers can warp alongside the piers, or nationalize or municipalize the lighterage business and operate it as a public utility in connection with the central markets, city canal system and motor delivery to the retail shops. Instead, however, of tackling the problem from this angle, the authorities seem to be reluctant to injure the lighterage business and the vested interests of Yokohama and are trying to compromise by starting immediate work on the construction of the much-talked-of Tokyo-Yokohama canal, which perpetuates the lighterage hold on the metropolis.

The plan for the canal was advocated years ago because of the constantly expanding traffic between the port and the capital and because transportation by water has been regarded as inadequate.

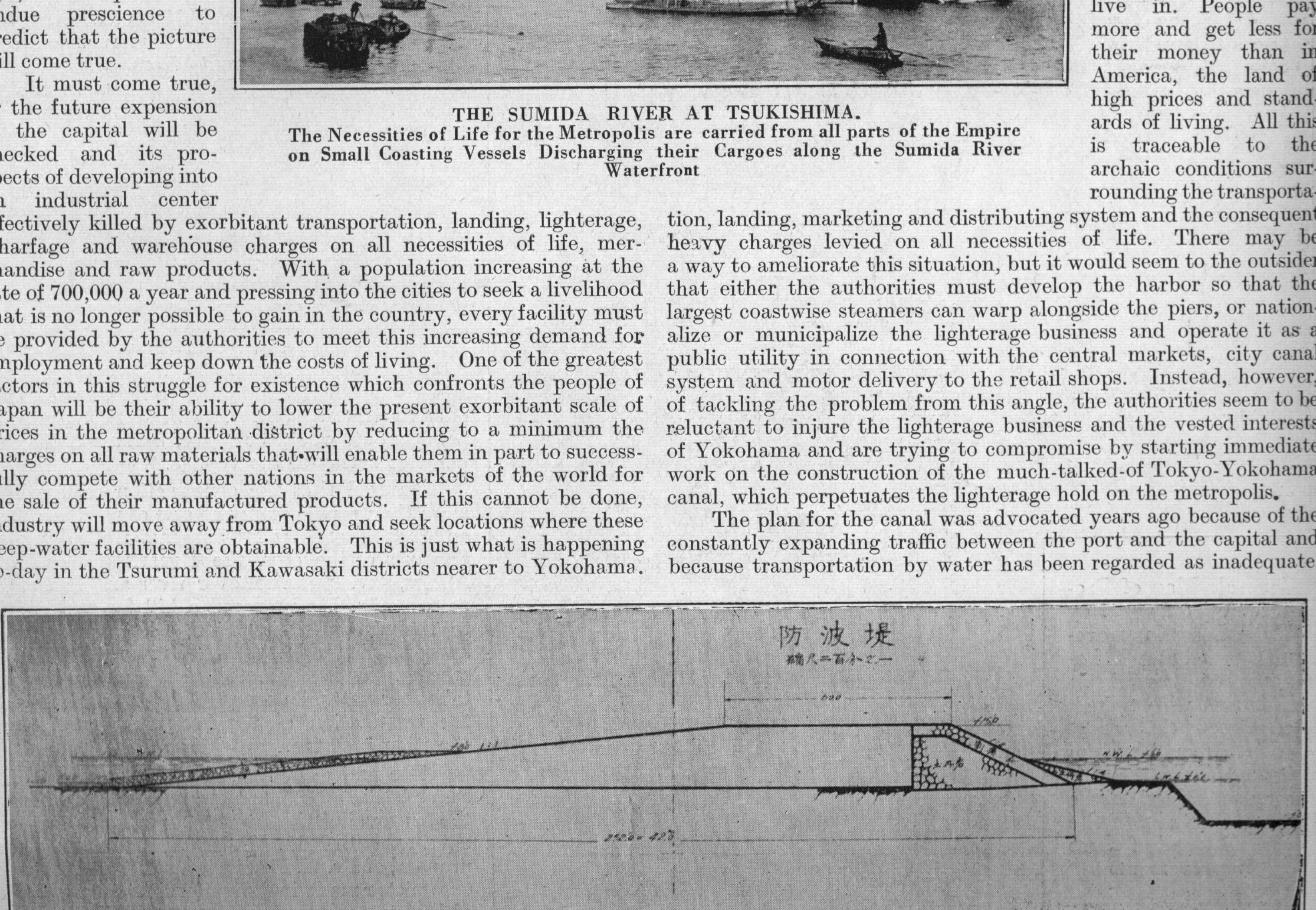


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Fig.1 Type of Breakwater for Tokyo Harbor Construction

General Plan of Proposed Tokyo Bay Water Front Improvements from Yokohama to Susaki in Tokyo. Owing to lack of funds this great scheme may be years in realizing. With some modifications the above map shows the general trend of these improvements

Approximately 80 per cent. of the merchandise landed at Yokohama from foreign and other Japanese ports must be trans-shipped for Tokyo, and about the same percentage consigned to Tokyo by train has to be forwarded to Yokohama. Of all the freight thus exchanged only 10 per cent. is transported by train.

Thousands of sailboats and lighters operate between the two points, but the constant delays and the damage frequently suffered in following the crowded water routes render the traffic unsatisfactory. Freight rates are out of proportion to the distance, and the costs of the commodities thus exchanged have been advanced accordingly.

A plan for the construction of the canal was proposed by the Reconstruction Board immediately after the great earthquake and fire, when building materials were urgently needed in Tokyo, at a time when 60 per cent. of the lighters engaged in this traffic were destroyed. In compliance with the Government policy for financial retrenchment the original plan was rejected. This program included the construction of a harbor in Tokyo, as well as the reconstruction of the Yokohama harbor. The part providing for the canal, however, was struck out. The Tokyo Municipality has since been engaged in rebuilding its harbor out of city funds and with the aid of the Government, while the reconstruction of Yokohama harbor has been progressing through the separate effort of the Home Department.

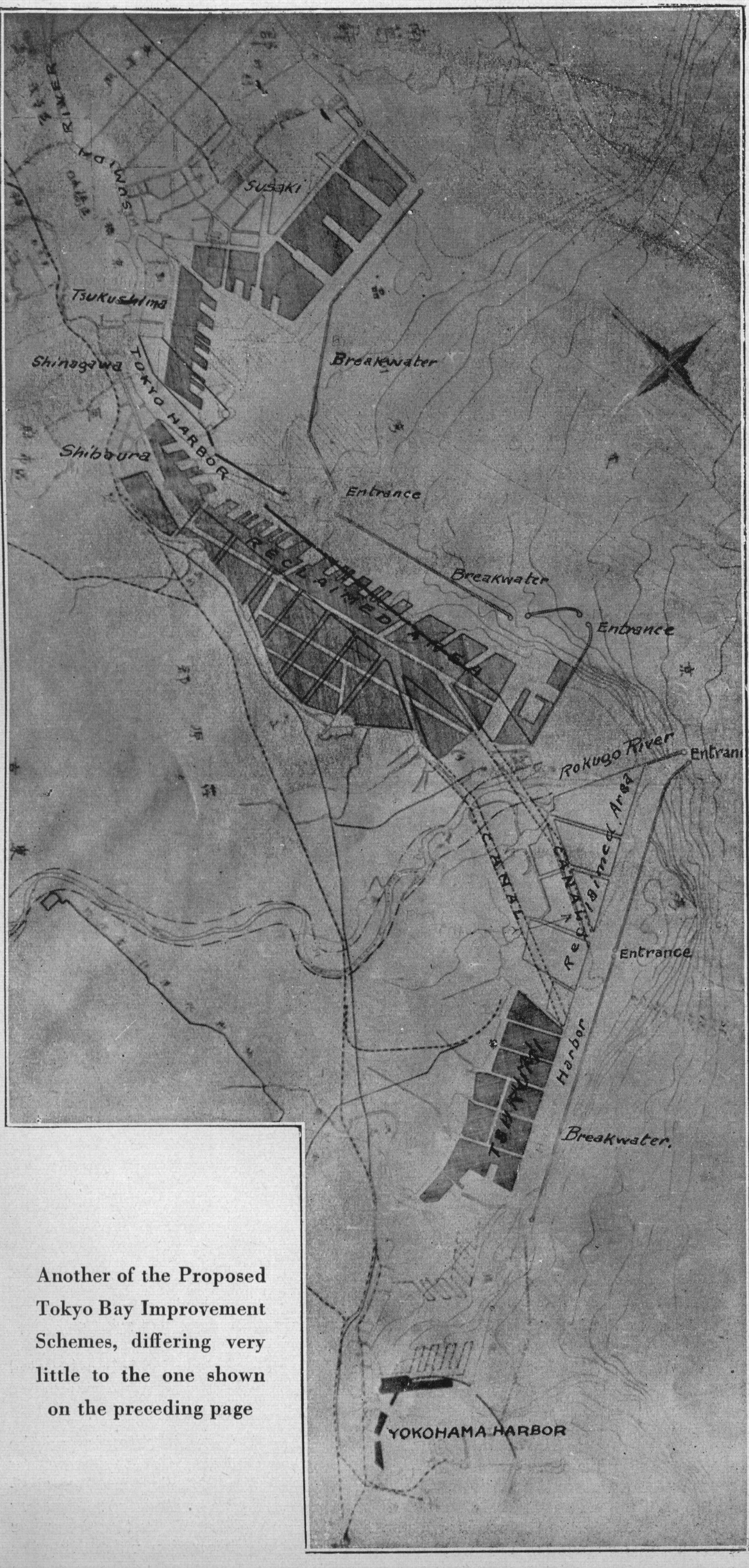
In view of the progress made in the construction of both harbors, the Government is now said to be inclined to favor the canal project in order to improve the freight transportation service.

In the earlier plan Y.17,000,000 had been estimated as the cost, but this is now increased to Y.20,000,000. The profit from the canal is estimated at Y.3,000,000 per annum in addition to the income to be derived from disposing of 560,000 *tsubo* of reclaimed land. If this can be sold at the low rate of Y.25 per *tsubo*, the total amount earned would aggregate Y.14,000,000.

The completion of the work would mean an end of the inconveniences to shippers occasioned by the unforeseen delays in the traffic. It is reported that twice during the past year water communication has been interrupted by storms, which take a heavy toll in lives and damage to the cargo. During the past two years 51 vessels carrying 5,100 tons of cargo were lost. Because of these adverse weather conditions, the lighters can make only 36 trips a year. The insurance rates, it is pointed out, would be lower, because of the comparative safety of the voyage.

Assured that the construction costs will be more than repaid from the sale of reclaimed land, and that the canal tolls would materially add to the revenues of the city, the Department of Home Affairs, having control over river and harbor improvements, has prepared a bill for presentation to the next session of the Diet asking for an appropriation of Y.20,000,000 to proceed with the scheme. It is estimated that construction will take four years, its completion synchronizing with the termination of the five-year general reconstruction program.

The project of a new harbor for Tokyo dates as far back as 1885, but owing to political reasons the approval of the Imperial Government was not obtained until 1911. In 1889, in accordance with a proposal of Dr. K. Furuichi, the City Improvement Committee made investigations concerning a plan of harbor construction suggested by M. Lenot, a



Another of the Proposed Tokyo Bay Improvement Schemes, differing very little to the one shown on the preceding page

French engineer; but as the improvement of the waterworks system was then under way and ought first to be completed, the plan was postponed.

Again in 1890 the then mayor of Tokyo, Mr. H. Matsuda, decided to meet the expense for harbor improvement from the city improvement fund with the consent of the Committee; and Dr. Furuichi and Dr. H. Nakayama were appointed to draft a plan for the work, which when completed was estimated to cost Y.41,000,000. The plan was passed by the City Council and received the approval of the City Improvement Committee. Accordingly a Harbor Works Investigation Committee was created and commissioners nominated to go thoroughly into the matter. In July of the same year the mayor asked the Minister of Home Affairs to advance Y.12,000,000 from the treasury by way of making a beginning. The petition, however, lay neglected for some years.

In 1896 the Committee decided to prepare its plans on a smaller scale, reducing the estimate to Y.35,700,000, and conferred with the governor of Tokyo prefecture with regard to the execution of the plans, but without any definite result. Prospects at once became more hopeful when Baron Sakatani became mayor of Tokyo, and in 1913 he presented a scheme designed by Dr. R. Naoki involving an estimate of Y.20,000,000, and in March the Committee voted the new plan.

There have been several schemes proposed from time to time since then for the improvement and expansion of Tokyo's harbor facilities, most of which have been discarded. We reproduce the plans of the two most important projects in order to show the ultimate scope of the work. One of these covers the comprehensive harbor scheme devised under Viscount Goto's term as mayor of Tokyo, calling for the huge expenditure of Y.350,000,000, spread over a period of thirty years. In this scheme the entrance to the harbor is off Haneda Point, where the Rokugogawa (Tama) empties into the sea. The breakwater was to extend for ten miles to a point near where the Nakagawa (now the Arakawa Flood Prevention Canal) empties into the bay. The Shibaura waterfront was to be improved for about 3½ miles, with warehouses and other facilities, transforming the district into a foreign trading quarter. The following details give a general idea of the scope of this scheme:

Total area of port	9,854,300 *tsubo*
	(approximately 8,200 acres)
Total dredged area	9,174,550 *tsubo*
	(approximately 7,600 acres)
Depth of anti-port ..	from 30 to 40 *shaku*
	(one *shaku* equals 11 inches)
Area of anti-port	419,200 *tsubo*
	(approximately 350 acres)
Depth of channel ..	from 12 to 36 *shaku*
Area of channel	3,959,250 *tsubo*
	(approximately 3,300 acres)
Depth of harbor ..	from 12 to 40 *shaku*
Area of harbor	2,894,900 *tsubo*
	(approximately 2,400 acres)
Depth of lighter harbor ..	8 *shaku*
Area of harbor	166,500 *tsubo*
	(approximately 138 acres)
Depth of canals connecting reclaimed lands	6 *shaku*
Area of the above canals ..	932,500 *tsubo*
	(approximately 770 acres)
Total area of reclaimed land ..	8,574,400 *tsubo*
	(approximately 7,100 acres)
Length of breakwater ..	8,230 *ken*
	(approximately 51,850 feet)
Total length of piers	12,944 *ken*
	(approximately 814,500 feet)

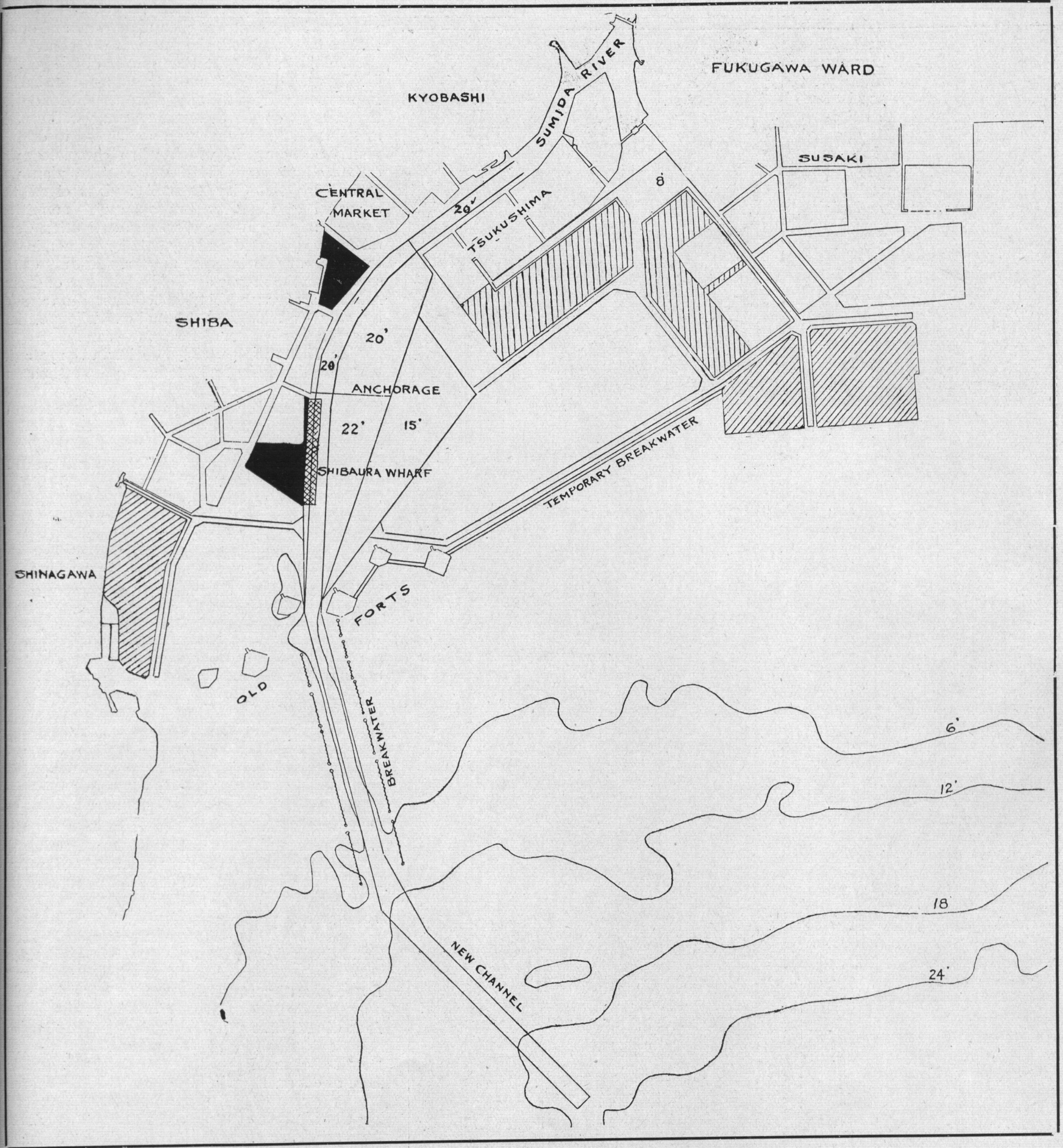


Fig. 3.—PRESENT CONDITION OF TOKYO'S HARBOR SCHEME

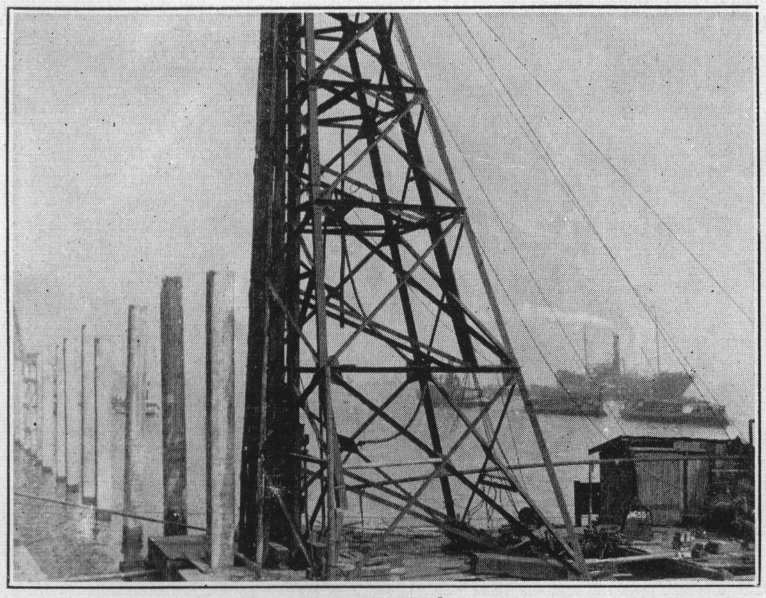
Black: Completed Reclamation; Shaded Parts: Reclaimed Areas one-half completed: Anchorage and New Channel, Dredging now going on

Effective length of piers .. .. .. 10,197 *ken* (approximately 641,000 feet)

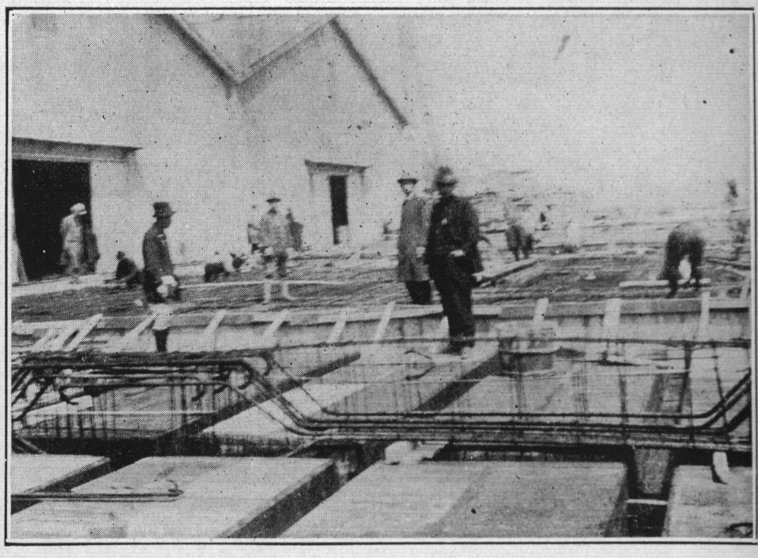
Total length of cargo loading and discharging wharfs .. .. 14,294 *ken* (approximately 900,500 feet)

At the mouth of the Sumidagawa piers for passenger boats will be constructed. Somewhere in the Tsukishima or the Etchujima districts a railway station to handle freight from the north-eastern parts of the mainland will be erected. The reclaimed land, between Nakagawa and Nakajima, is to be used for ship-building yards and factories. The rent on these lands is calculated by the Tokyo municipal authorities as an important source of revenue with which the cost of constructing the harbor will be met.

This elaborate scheme fell through for lack of funds, and the demand on the treasury for other urgent reconstruction work has compelled its abandonment. Nevertheless, this plan may be accepted as the basis for future harbor expansion, a guide to be followed as far as the funds will permit. A new and less pretentious plan has since been drawn, eliminating the pier construction and shifting the harbor mouth to a point off the Omori foreshore, as shown on the



Shibaura Harbor



Large Sheds on Quay at Shibaura

map. Even this plan is too costly for the city to undertake with its present limited finances, so a much smaller program is now actually being executed with the funds available.

For this purpose the sum of Y.6,800,000 was appropriated in 1922 to deepen the mouth of the Sumida river. The demands on the harbor facilities following the earthquake impressed the authorities with the inadequacy of this step to meet the demands of the shipping, and a further Y.12,200,000 (a total of Y.19,000,000) was appropriated last year to cover further improvements up to 1931. On these limited funds the city is now carrying forward the harbor work as outlined in Figure 3.

The plans provide for dredging a 22-feet channel from the Shibaura wharves out between the third and fourth forts into the bay for a distance of 13,500 feet, following the present channel for 10,320 feet, and from there on a new channel will be dredged for the remainder of the distance. This will enable a limited number of 5,000 to 6,000-ton vessels to come alongside the Shibaura wharves. Inside the breakwater an anchorage of varying depth is to be dredged. From the fifth fort north to Tsukishima, as shown in the plan, an area of 745,300 *tsubo* will be dredged, 287,800 *tsubo* of which will have a depth of 15 feet in order to accommodate 40 vessels of 500 to 1,000 tons. Another adjoining section will be sub-divided; the first, covering 225,400 *tsubo*, will be dredged to 20 feet, and the other, covering 207,000 *tsubo*, to 22 feet. This anchorage will accommodate 29 vessels of 1,000 to 3,000 tons. At Shibaura the depth will be 25 feet, permitting six 5,000 to 6,000-ton ships to moor alongside the wharf, which is to be 3,000 feet long. The harbor will be protected by a temporary breakwater of the type shown on Fig. 1, extending from the fourth fort to a point on the reclaimed land off Susaki.

It is estimated that the soil dredged from the channel and anchorage will provide 2,549,877 cubic *tsubo* for reclaiming the seven sections shown on the plan, Fig. 3. The new land will be twelve feet above datum and protected with heavy piling and bulkheads. The 1st area is 41,460 *tsubo*; 2nd area 57,700; 3rd, 181,723 *tsubo*; 4th, 143,612 *tsubo*; 5th, 326,708 *tsubo*; 6th, 277,634 *tsubo*; and 7th, 123,200 *tsubo*, a total of 1,062,037 *tsubo* that will be sold at a minimum of Y.25 per *tsubo*, providing a revenue of over Y.40,000,000.

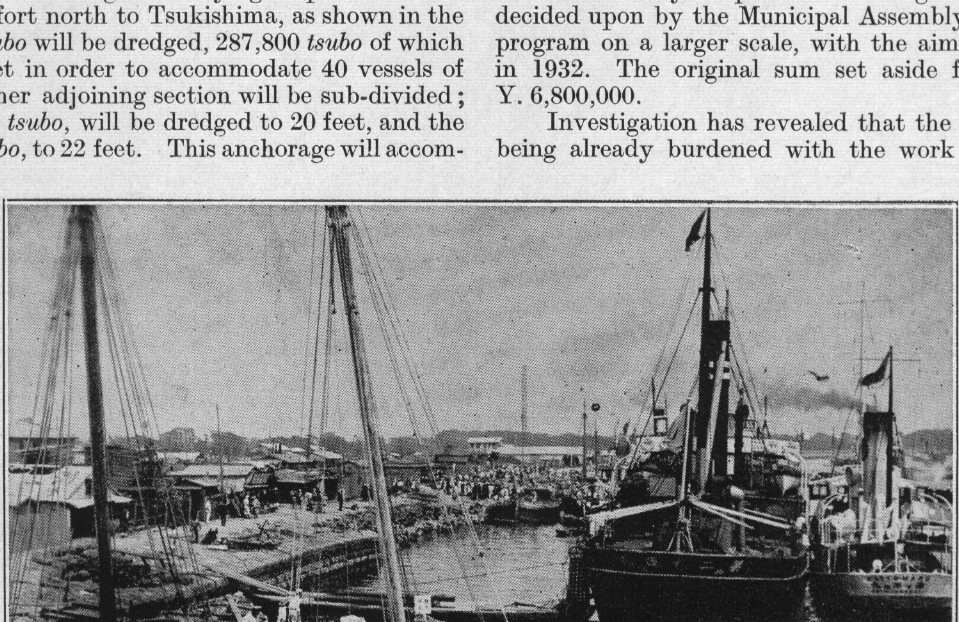
It will be seen from this brief outline of these plans that a very small part of the more important scheme is being carried forward. There is still a vast amount of valuable reclamation work in straightening out the shore line from Shibaura to Haneda Point, and still another equally important addition from there south to the limits of the Tsurumi Reclamation. The Keihin or Tokyo-Yokohama canal is in reality a waterway protected behind the breakwaters except for that part where it crosses the mouth of the Rokugo river.

Present Program

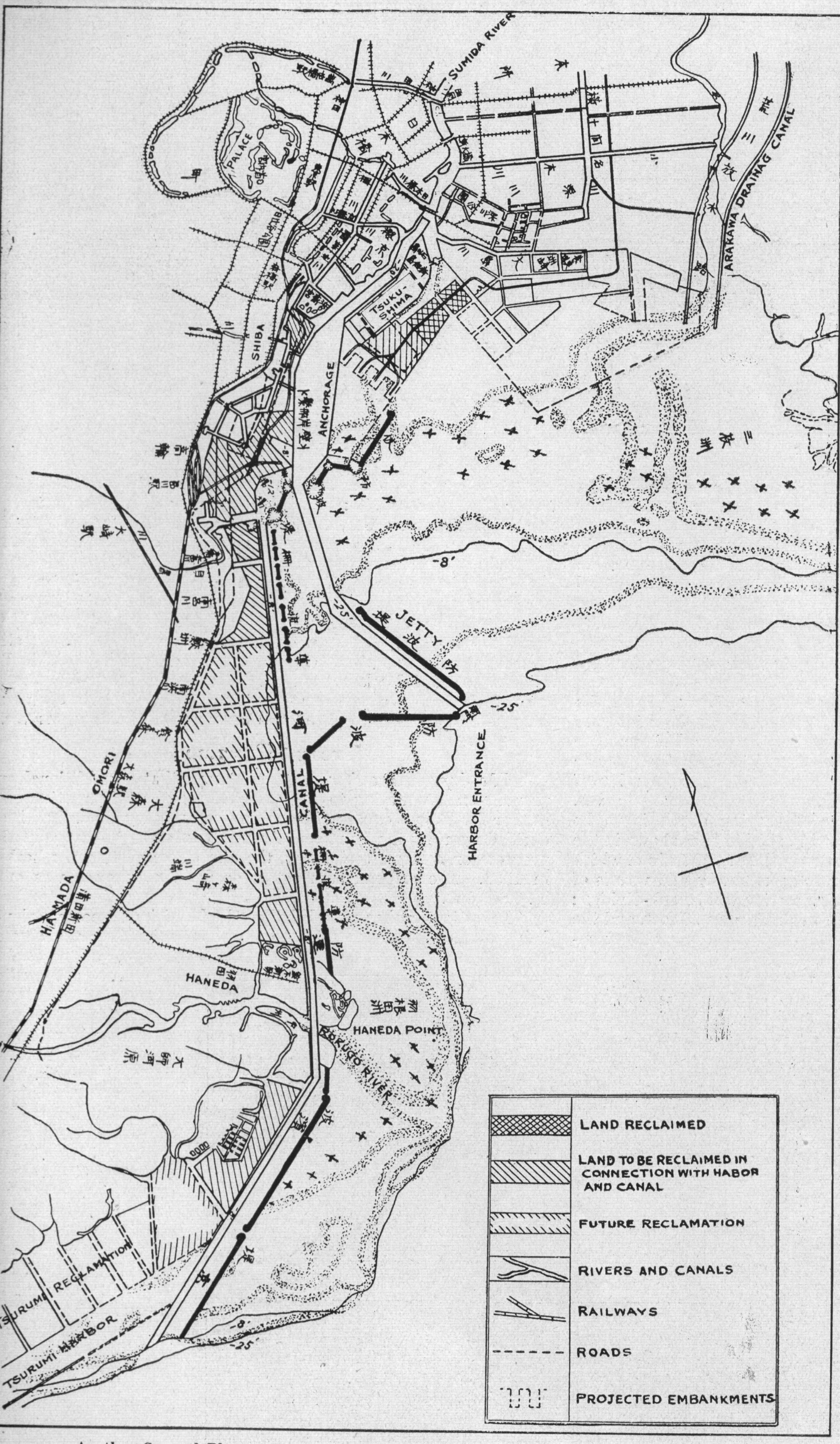
The Japan Advertiser of June 19 says that an additional appropriation amounting to Y.12,210,000 for the construction of a harbor for Tokyo capable of docking ocean-going liners has been decided upon by the Municipal Assembly in order to carry out the program on a larger scale, with the aim of completing the harbor in 1932. The original sum set aside for the purpose was only Y. 6,800,000.

Investigation has revealed that the Municipal treasury alone, being already burdened with the work of rebuilding the city of Tokyo, will be unable to meet the entire appropriation. Consequently the city is expecting to receive a subsidy from the Government and Mr. Tanuma, one of the deputy mayors of Tokyo, has already opened negotiations to that end with the Government authorities. The request from the Municipality is said to have received a warm welcome from the officials of the Department of Home Affairs, who are planning to make an investigation of the new harbor scheme before rendering a formal decision as to the granting of the funds.

The authorities of the Department are reported to be inclined



Tokyo's Antiquated Water Front. Unloading Relief Supplies at Shibaura Wharf immediately after the Disaster. Since then New Wharves and Warehouses have been built



Another General Plan of Tokyo Harbor Improvements, published in the Report of the Reconstruction Bureau

to give a subsidy of several million Yen to support the project. Even prior to the announcement of the plan by the city authorities federal officials had discussed plans for the construction of a harbor for Tokyo in connection with the proposed digging of a canal between Tokyo and Yokohama. The Government, however, abandoned its original intentions when it saw the plans conflict with the project of the Municipality.

The reclamation work so far carried out has cost about Y.7,000,000, and the area of the reclaimed land is estimated at about 80,000 *tsubo*. There are still about 210,000 *tsubo* of land to be reclaimed along the shore south of Shinagawa station and near the site of the Shiba Imperial detached palace. The Municipality is planning to dispose of all land reclaimed in the course of the construction of the harbor at an average price of about Y.50 per *tsubo* in order to raise funds to carry on the work. The Government authorities consider the price expected by the Municipality to be a little too high, but a more thorough investigation will be made immediately, so that the Government may act intelligently in the matter at the end of next month, when the national budget for the next fiscal year is composed.

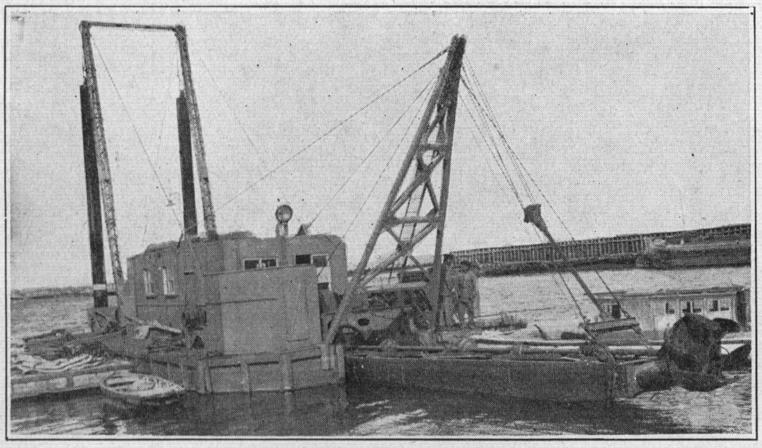
Shibaura Wharf

Tokyo will have a new pier at Shibaura by the end of June as a starter on the construction of the greater harbor plans here, according to a recent announcement by the authorities in charge of the work of building the new dock.

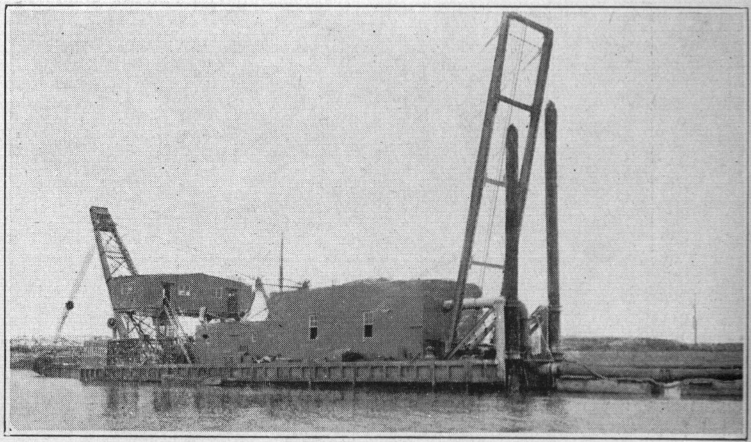
The length of the pier is 310 *ken*, and it is 7½ *ken* wide. When it is finished at least six vessels, each displacing about 3,000 tons, will have room alongside at the same time. A celebration marking its completion is planned by the Municipal authorities.

In the meantime the site for more land that is to be reclaimed in accordance with the harbor plans at the mouth of the Sumida river has been designated and has been submitted to the Department of Home Affairs for approval. The plan was revised at a recent committee meeting on harbor construction in the Municipal Assembly. It calls for the reclamation of 1,062,037 *tsubo* of land.

(Continued on page 432).



No. 4 Hydraulic Dredge



Hydraulic Dredge, "Suehiro Maru"

TSURUMI

Transforming a Swamp into a Modern Industrial Center

The Work of The Tokyo Bay Reclamation Company

THE delay on the part of Tokyo's Municipal authorities to provide adequate harbor facilities for promoting the industrial growth of the city has created a movement that is diverting the erection of new manufacturing plants to localities along the bay front with access to deep water where they will be freed from exorbitant unloading, lighterage and warehouse charges. Tokyo's unstrategic commercial location, unless rectified by huge harbor improvements, will be capitalized by Yokohama and Kanagawa. The future commercial greatness of Tokyo is so bound up in its harbor that unless up-to-date facilities are provided that will lower the charges on raw materials and essential food supplies the business men of Japan will meet the situation by developing a new deep-water industrial center in the vicinity of Yokohama.

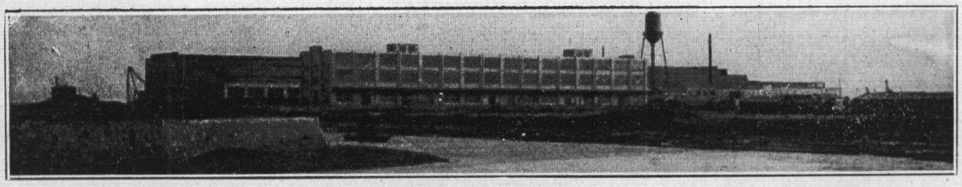
This idea was evidently in the mind of Mr. Soichiro Asano, the veteran shipping magnate of Japan, when he organized in 1912 the Tsurumi Reclamation Association for the purpose of reclaiming and improving the low-lying land at the mouth of the Tama river, near Tsurumi, converting it into an industrial district with deep-water shipping facilities. A million and a half *tsubo* was reclaimed by this Association before its work was taken over by a company organized for this purpose, called the Maichiku Kabushiki Kaisha. This company carried on until 1920, when it merged with the Tokyo Bay Reclamation Company, Ltd., which has continued the operations to date.

On the sea side of this reclaimed area a protected harbor 1,500-ft. wide is being dredged to a depth of 30-ft. in order to provide anchorage for 10,000-ton steamers. To facilitate water transportation with all parts of the reclaimed area canals are being dug of sufficient width and depth to allow lighters and launches to come alongside the foreshore of the various industrial establishments erected in the new district to take advantage of this great saving in their cost of production.

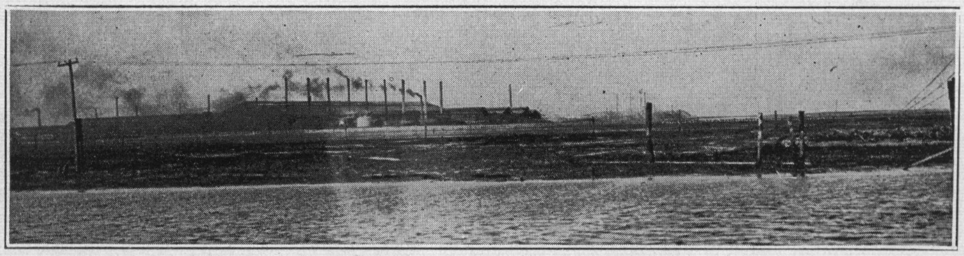
The harbor itself will be 1,500-ft. wide and 13,560-ft. long, with a water surface of 600,000 *tsubo*. Up to within 180-ft. of the shore line the harbor will be dredged to a depth of 30-ft. at low tide, and an entrance channel of the same depth will be dredged for a distance of 5,060-ft. to the outer deep-water harbor at Yokohama.

The harbor will be protected on the bay side by a breakwater 13,560-ft. long, at a distance of 1,956-ft. from the shore line. The breakwater is being constructed (as shown in the accompanying plans) of concrete blocks laid on a rock foundation varying in form according to the depth of the water and carried to one foot above the highest tide recorded in Tokyo Bay.

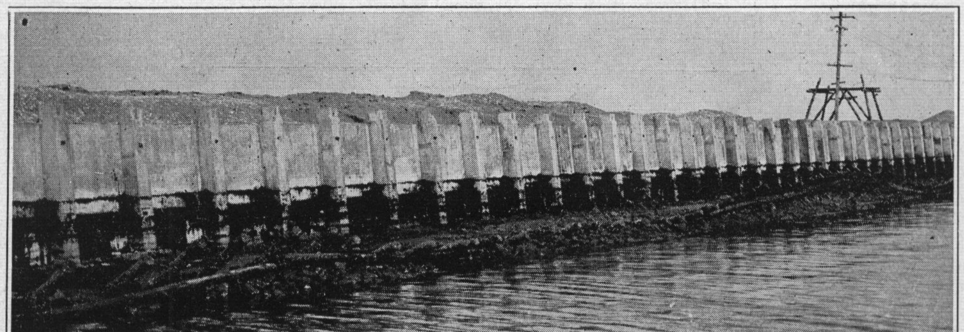
The several reclaimed sections are to be cut by canals, as shown on the map, having a top width of 240-ft. sloping to



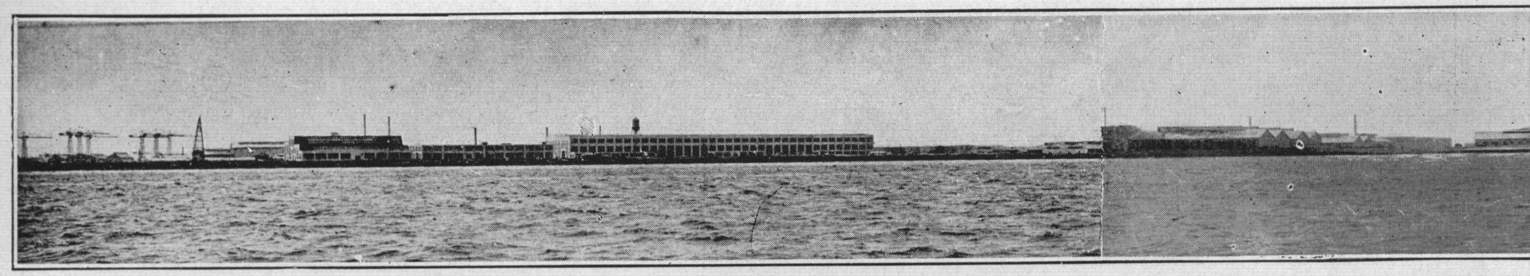
Shibaura Engineering Works at Tsurumi



Site Before Reclamation



Reinforced Concrete Sea Wall Nearly Completed



Asano Shipyards: Asano Steel Works: Shibaura Engineering Works: Standard Oil Co.:

THE NEW TO

162-ft. at the bottom, with a depth of 10-ft. at low tide. These main canals will have a total length of 25,380-ft. The main canal leads into one that has been dug by the Keihin Electric Tramway Company for its own use. These canals are to be protected, as shown in the drawings, by employing a two-step bulkhead inthe 1st district, and in the others a concrete sea-wall type.

The reclaimed area is divided into nine districts. Districts 1 to 3 are not yet sufficiently advanced for erecting heavy buildings, but on No. 4 is found the splendid new plant of the Nisshin Flour Company. On the other extremity of this block will be erected a steam-generating plant with an ultimate capacity of 140,000 k.w. for the Tokyo Electric Power Company, a subsidiary of the Toho Electric Power Company, whose activities are described in another part of this number of THE FAR EASTERN REVIEW. On the other half of District 4 will be another steam generating plant with an initial capacity of 15,000 k.w. operated by the Nippon Electric Power Company, while just outside the reclaimed area, to the north of the 4th district, is located the plant of the Fuji Electric Wire Company.

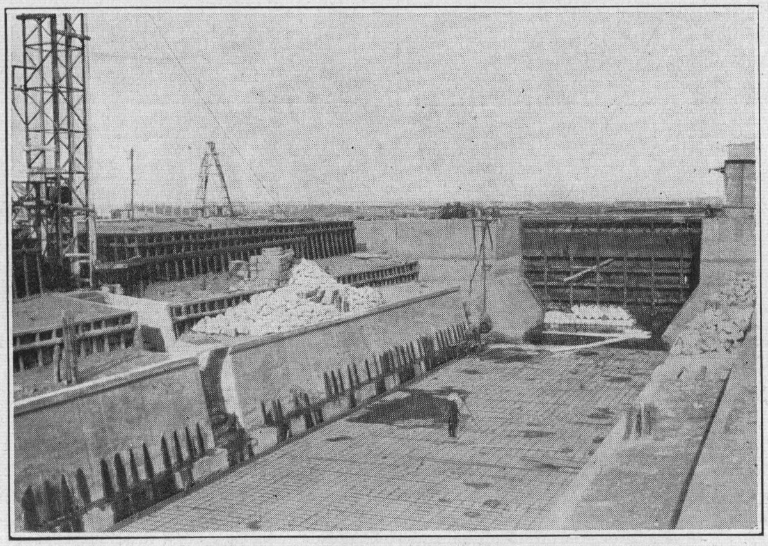
On the harbor side of the 5th district is found the tank installations of the Rising Sun, Nippon Oil and Standard Oil Companies and the Oil Department of the Mitsui Bussan Kaisha. In the northern half of the 5th district is located the office of the Tokyo Bay Reclamation Company and the new works of the Ishikawajima Shipbuilding Company, and just outside the reclaimed area are the saw mills of the Akita Lumber Company.

Across the canal on the 6th district the great new plant of the Shibaura Engineering Works is in process of erection. This is also described in another part of this number of THE FAR EASTERN REVIEW. Next door are the up-to-date Asano Shipbuilding Yards, erected during the war at an enormous outlay of capital, and across the canal in the 7th district is the new plant of the Asahi Glass Company, the finest in Japan. Adjoining this is the installation of the Chiyoda Oil Company, and then comes a sawmill operated by the Asano interests.

On that section of the reclaimed area known as Wakao Shinden are the works of the Japan Steel Tube Company, the South Manchuria Mining Department, and the Truscon Steel Company of Japan. To the east of these is found the plant of the Asano Cement Company, the largest in Japan, strategically located to supply the great reconstruction demands of the metropolitan district. Just north of this district is the Hamakawa transformer station of the Tokyo Bay Reclamation Company, receiving power from the company's own water plant in the Fuji district.

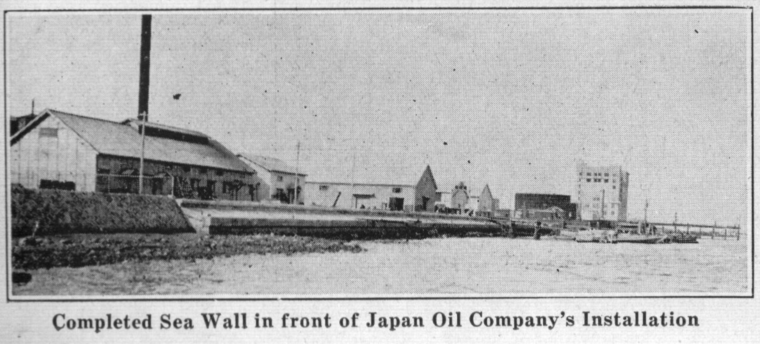
With this grouping of great industries in the Tsurumi district a start has been made that will be followed by other important factories seeking the facilities difficult to obtain in Tokyo.

In the general plan of the projected Tokyo Bay improvements will be noted certain other sections to the north-east of the present reclaimed area, which the Tokyo Bay Reclamation Company is seeking to obtain permission from the Government to reclaim and develop. This would carry their operations to the mouth of the Tama river and connect with the plans of the Tokyo Harbor authorities. The main sewer disposal plant is to be located on reclaimed land at this point. The same plan shows the general

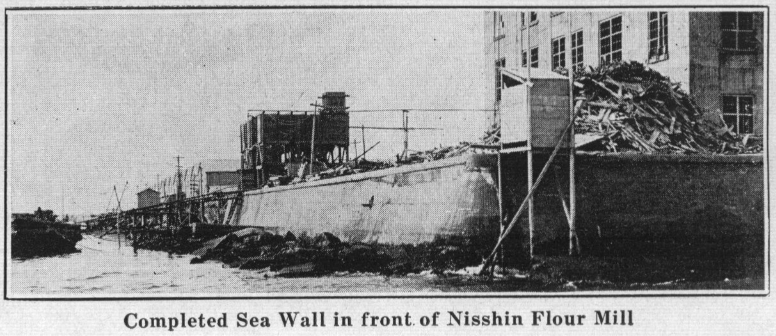


Asano Dry Dock at Tsurumi; Making Concrete Caissons for the Breakwater

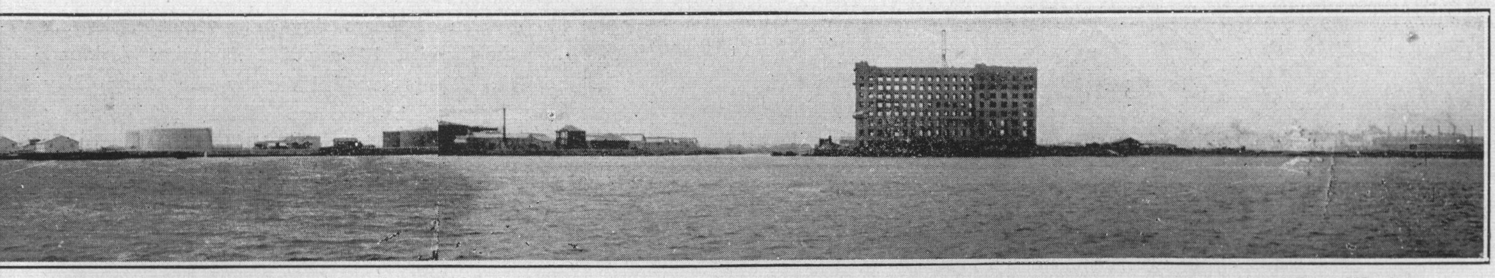
Completed Breakwater



Completed Sea Wall in front of Japan Oil Company's Installation



Completed Sea Wall in front of Nisshin Flour Mill

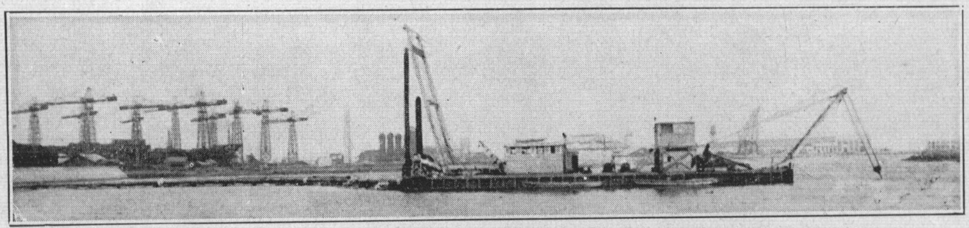


Mitsui Oil Tanks: Rising Sun Oil Co.: Nisshin Flour Mill: Japan Steel Pipe Works

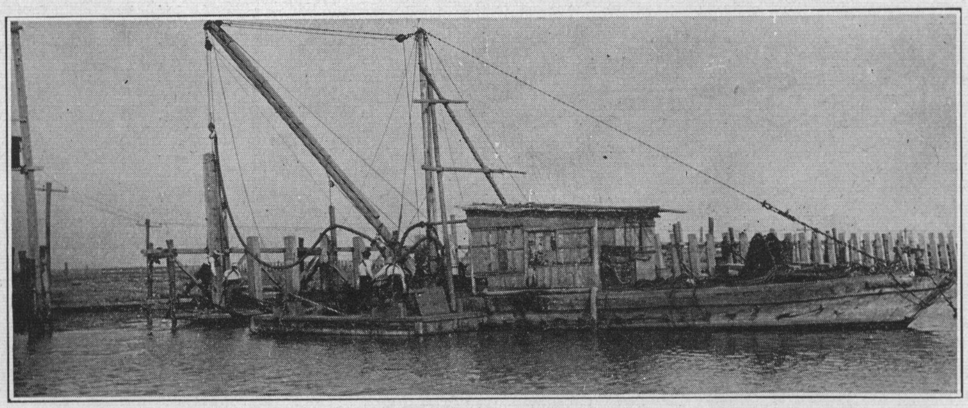
RONT AT TSURUMI

outline of the projected Tokyo harbor improvements, which include the reclamation of the foreshore from the mouth of Tama river to the mouth of the Arakawa flood prevention canal.

Up to the mouth of the Tama river the breakwater protecting the harbor of the Tokyo Bay Reclamation Company forms the main section of the much-talked-of Tokyo - Yokohama canal, which from that point would follow a dredged passage across the mouth of the Tama and connect with the canals forming part of the Tokyo harbor improvements, also protected by a breakwater for its entire length. It may take some years to realize this project, but it will take shape gradually, and another 25 years will see this foreshore development created in order to satisfy the needs of a city which hopes in that time to have a population of over 7,000,000.

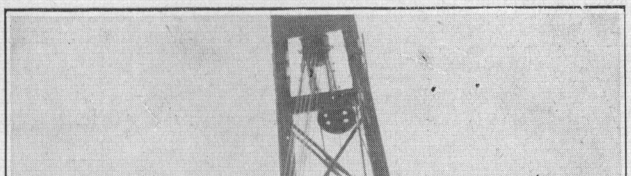


No. 1 Hydraulic Dredge; Asano Shipyards to the Left

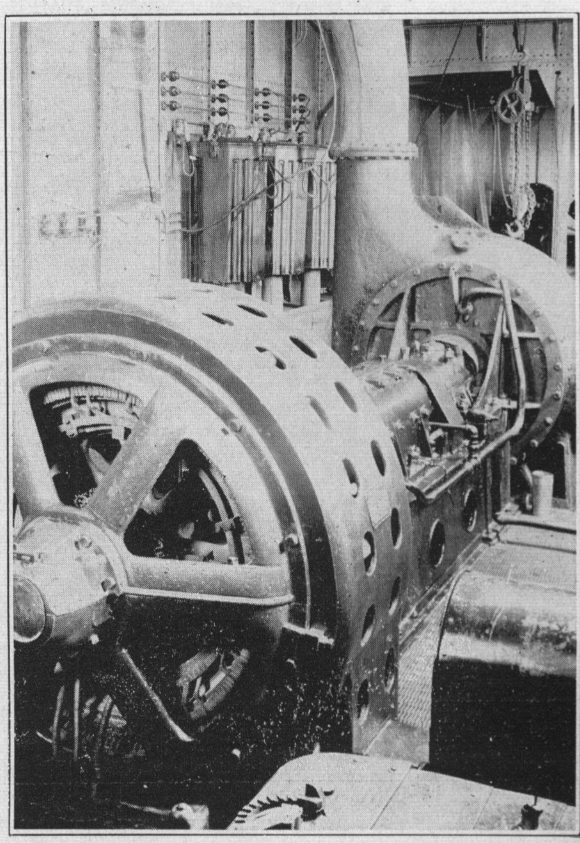


Reinforced Concrete Sea Wall under Construction

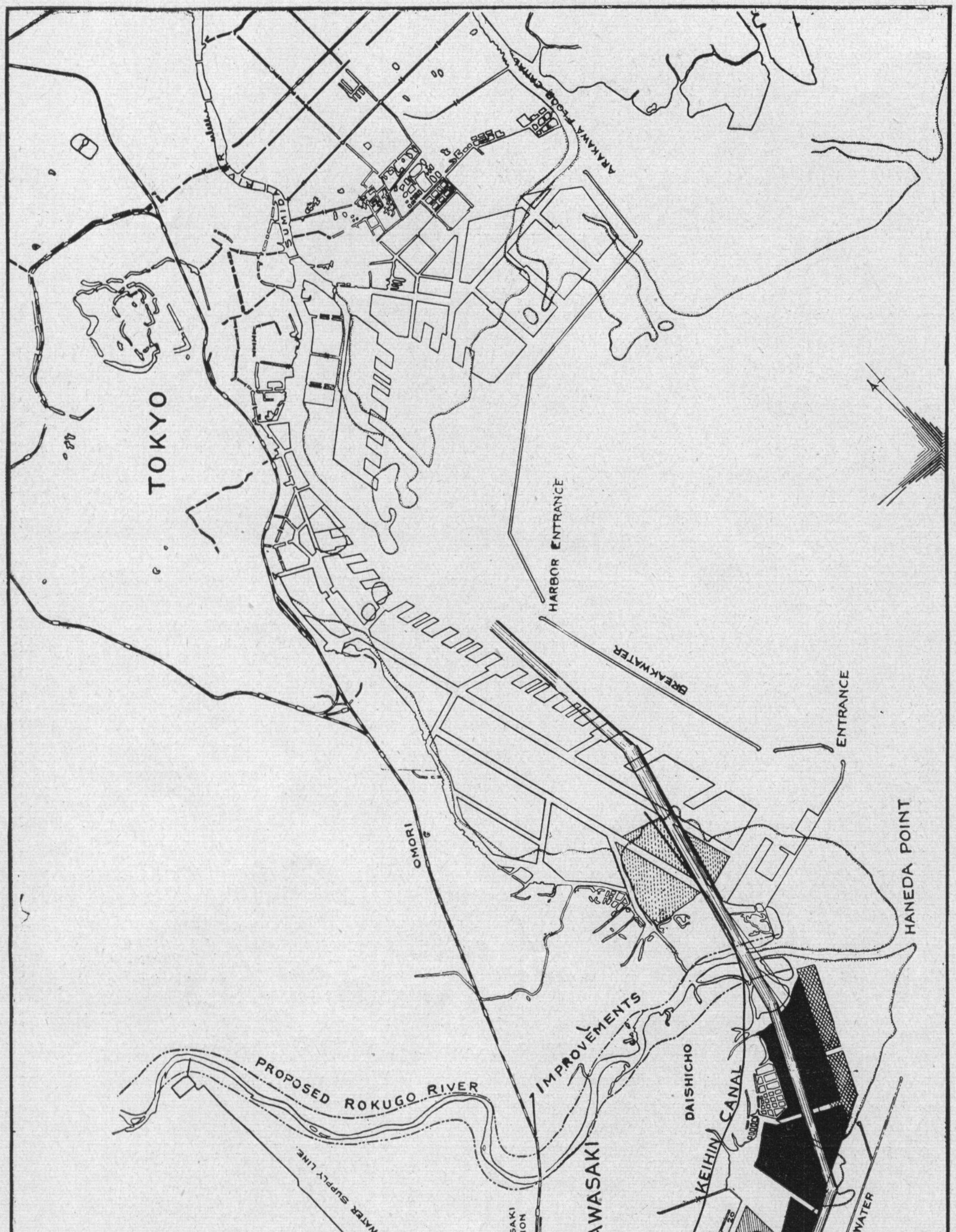
In addition to the major work of the Tokyo Bay Reclamation Company it will connect the roads of the reclaimed area with Shiomibashi on the national highway by a private road 606-ft. long and 24-ft. wide. From Shiomibashi along the left bank of the Tsurumi river another road, 3,120-ft. long and 24-ft. wide, will lead to the 4th district, and another from the same place to the 6th district, 3,780-ft. long and 24-ft. wide. From the town of Kawasaki to the Japan Steel Tube Works at Wakao Shiden another road, 8,394-ft. long and 24-ft. wide, will be built, a total of 15,831-ft. of new roads. The road from the 7th district to Oshima Shinden, a distance of 16,800-ft., will be widened from 9 to 12-ft. All bridges necessary for these roads will also be built at the Company's expense.



Cutter Head, "Suehiro Maru"



Pump Room, "Suehiro Maru"

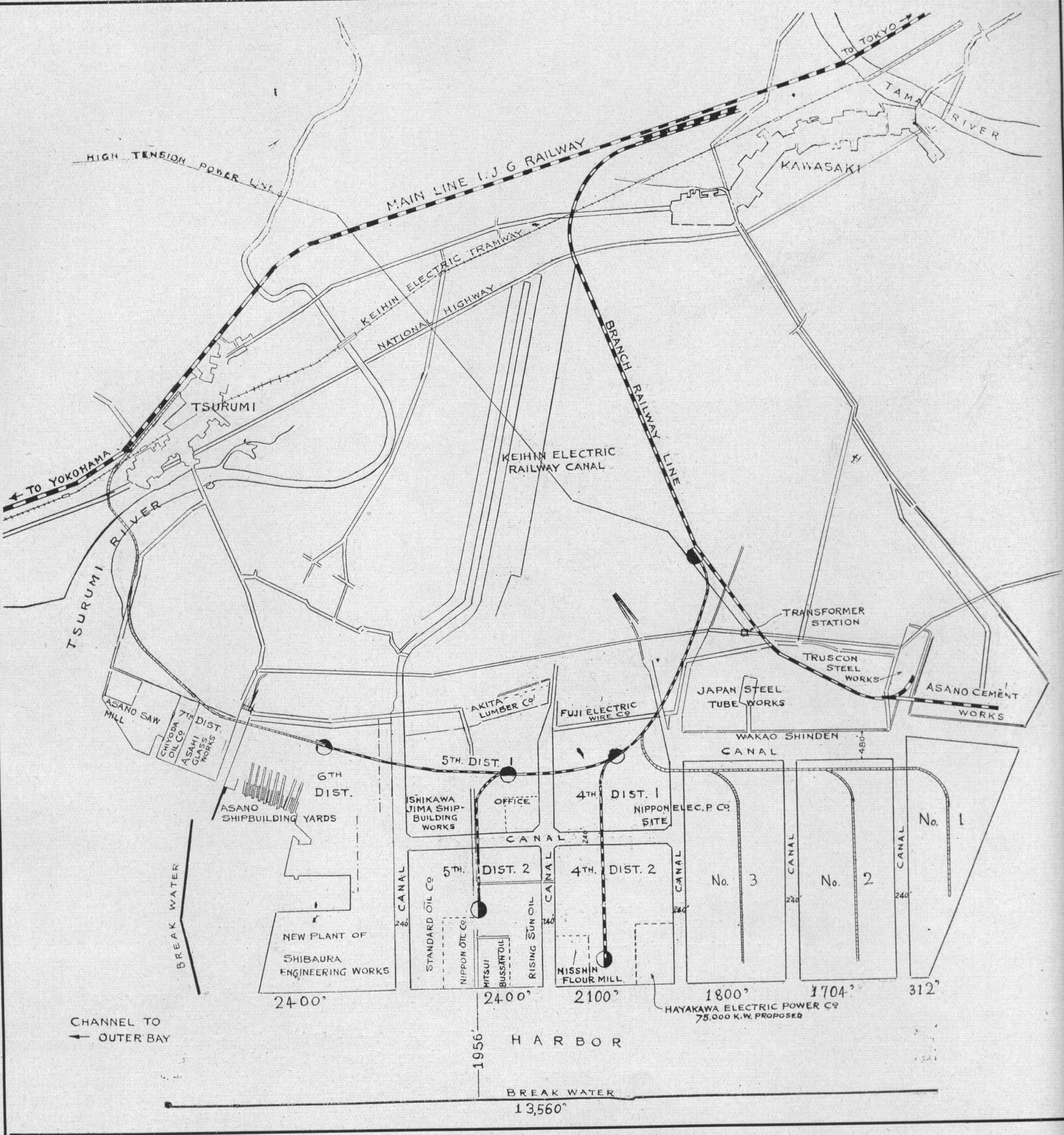


Plan of Tokyo Bay Improvements, showing the Completed Tsurumi Reclamation Work and the Rights applied for by the Tokyo Bay Reclamation Company. The Plan also outlines the future Tokyo and Yokohama Harbor Extensions and the location of the Canal connecting the two cities.

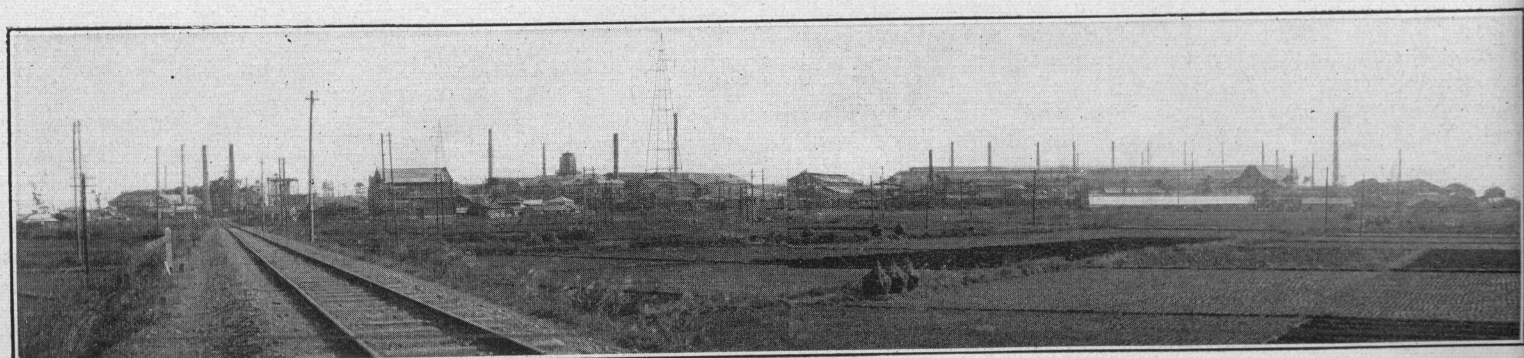
1. Tsurumi Wood Works
2. Naigai Petroleum Company
3. Chiyoda Petroleum Company
4. Asahi Glass Mfg. Company
5. Asano Shipbuilding Yard
6. Asano Iron Works
7. Shibaura Engineering Works
8. Ishikawajima Shipbuilding Company
9. Standard Oil Co. of New York
10. Nippon Petroleum Company
11. Mitsui Oil Department
12. Tokyo Bay Reclamation Co.'s Dry Dock
13. Rising Sun Petroleum Company
14. Nisshin Flour Mfg. Company
15. Tokyo Electric Power Company
16. Nippon Electric Power Company
17. Fusi Denki Seizo K.K.
18. Japan Steel Tube Company
19. Tokyo Bay Reclamation Co.'s Sub-station
20. Asano Cement Company.

For the present, a branch line connects the Asano Cement Works at Oshima Shinden with the main Government railway at Kawasaki station, 2½ miles distant. Late on branches will be carried to all the other districts in the industrial area.

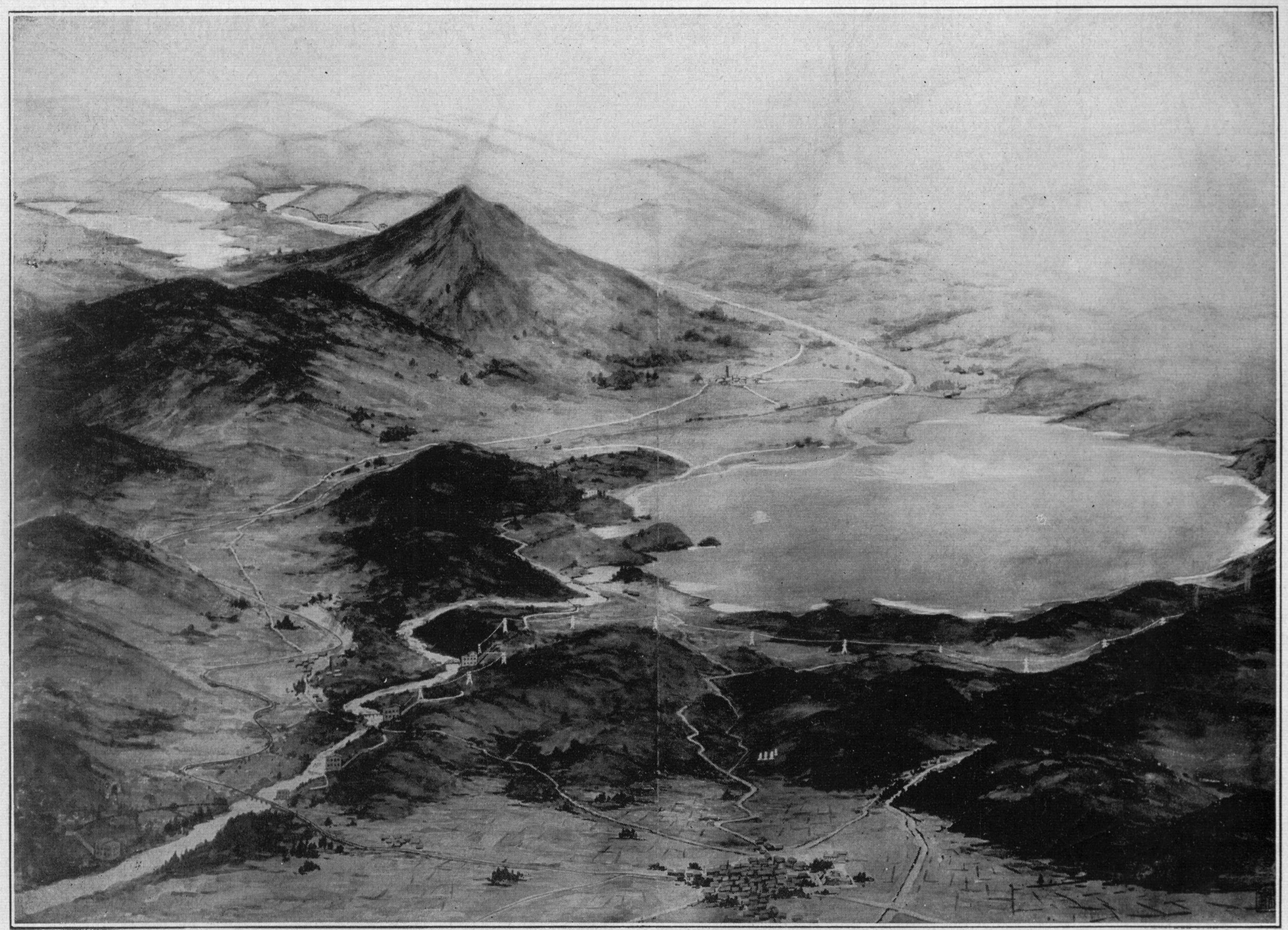
The Company operates its own hydro-electric power station on the Sakawa, in Ochiai (42 miles distant), having a capacity of 8,250 k.w. There are three 2,750 k.v.a. generators operated by three 4,300 h.p. impluse water wheels. The output of over 12,000 h.p. is purchased by the plants in the industrial area, and to meet the increased power demand two other producing companies are erecting steam plants in the district. The Reclamation Company also operates its own water system, having erected reservoirs, filtration beds and pumping plant seven miles up the Tama river large enough to take care of all future needs of the district. Water mains carry the supply to all parts of the industrial area. A dry-dock and repair shop operated by the Reclamation Company will also be added to the equipment of the district.



General Plan of Tsurumi Reclamation



The Japan Steel Tube Works at Tsurumi



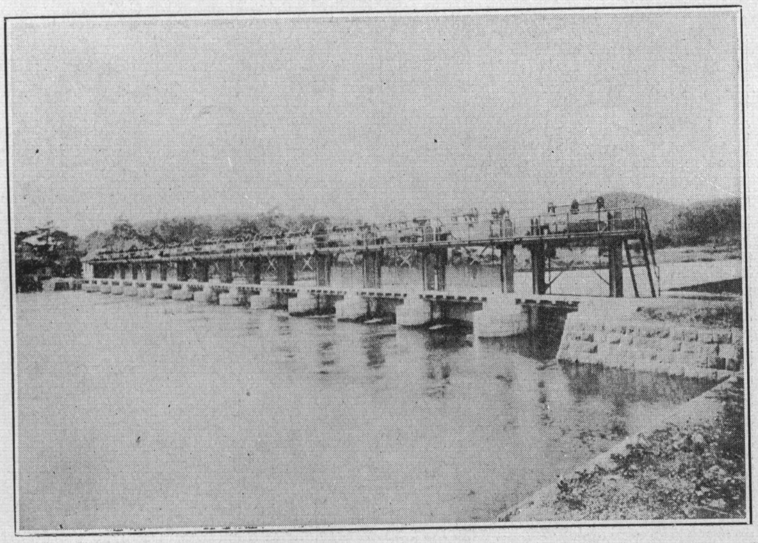
Lake Inawashiro, Showing Location of Four Tokyo Electric Light Company's Power Plants

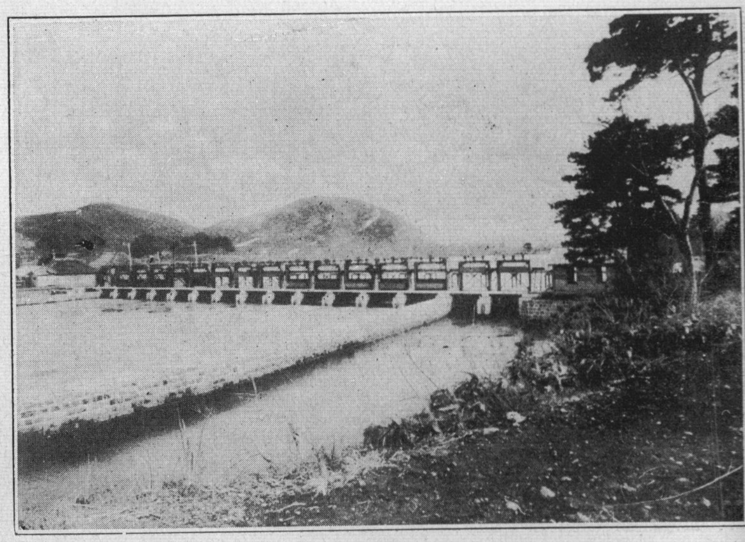
TOKYO
A Million Kilowatt City

The Phenomenal Growth of the Tokyo Electric Light Company

SUPPLYING 4,000,000 electric lights and a gross total of nearly 300,000 k.w. of combined light and power at the end of 1924, the Tokyo Electric Light Company is now building 70,000 k.w. of new power plants, with a further 230,000 k.w. under projection. When we add to this 600,000 k.w. output the power available from the Daido, Kinugawa, Tokyo Electric Power (a subsidiary of the Toho Electric Power Company) and other companies feeding into the Tokyo district, the total supply is not far from a million kilowatts, excluding the power now generated and the new stations projected for operating the State railways and the Tokyo Municipal Electric Bureau. The total power output of the whole empire at the end of 1923 was 1,307,000 k.w. from hydro-electric installations and 755,000 k.w. from steam power plants, with a total of 21,690,000 electric lamps. The total authorized capital invested in the electric light and power business at the end of the same year was Y.2,366,-844,961, of which Y.1,703,194,756 was paid in, and Y.585,634,054 in outstanding debentures. Of this grand total, about one-tenth represents the capital of the Tokyo Electric Company (Y.258,000,000 authorized and Y.193,769,880 paid in), with Y.29,450,000 of indebtedness and Y.12,380.000 reserves. The Company's business district covers 12 prefectures: Tokyo, Kanagawa, Shizuoka, Yamanashi Chiba, Saitama, Gumma, Tochigi, Ibaragi, Nagano, Niigata, and Fukushima, including the cities of Tokyo, Yokohama, Hachioji, Yokosuka, Shidzuoka, Maebashi, Takasaki, Ashikaga, Kiryu, and Nagaoka. The total area of the above districts is nearly 9,000 square miles, or about one-tenth of the size of the main island of Japan. It is not necessary to go beyond these figures to establish the position of the Tokyo Electric Company as the premier public enterprise in Japan. They are also indicative of the rapid growth of power demand for the city of Tokyo and the keen competition that is taking shape in order to meet it.

The number of lamps in the city of Tokyo has increased from zero to four and a half millions in the past thirty years, doubling in the past four years. The increase in the capacity of motors has grown even faster than the lamp load, and the phenomenal growth of the district as a manufacturing centre is creating demands upon the generating companies that for the next ten years will tax their ability to cope with. To meet this condition, the ordinary method of building an individual sub-station supply from a series of power stations has proved inadequate, and it is now planned to connect the numerous sub-stations of the Tokyo



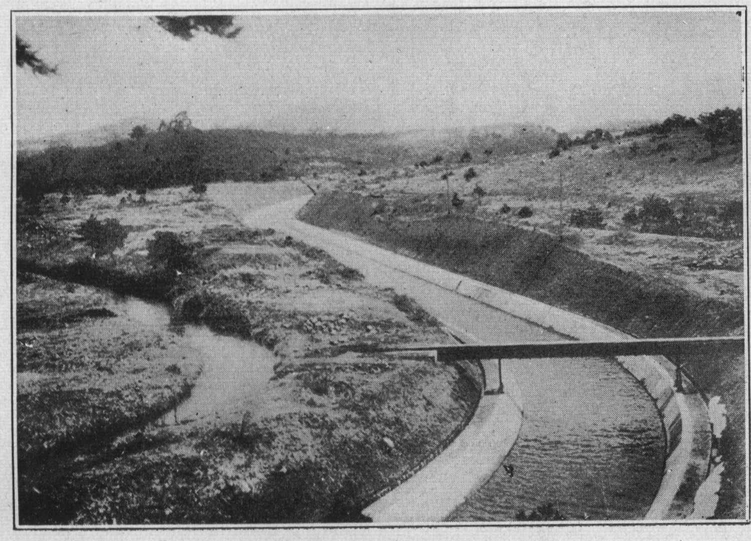


Regulating Gates of "Joruku-Kyo," the Intake at Lake Inawashiro to the Power Canal leading to No. 1 Inawashiro Power Station

Electric Company with two complete rings around the city of 154,000 volts and 66,000 volts.

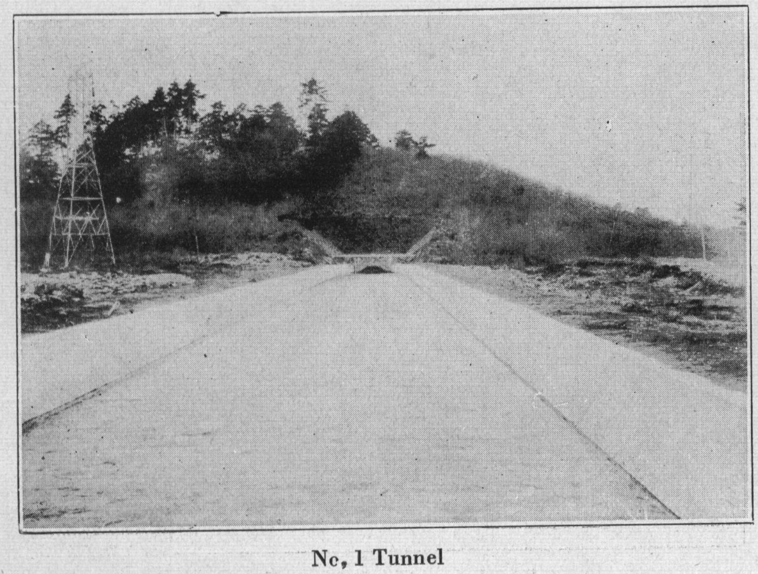
This power will be furthermore reduced in voltage and brought into the city by underground cables, as provided for in the general reconstruction plans for sub-surface work, at 22,000 volts and distributed at numerous sub-stations at voltages not exceeding 3,300. Suitable distributing transformers will again reduce the potential for the 220 volt motors and 100 volt lamps. The total power thus concentrated in the belt lines after present plans are fully developed will not be less than 750,000 k.w., which would meet the estimated demands of Tokyo by the year 1935. To supply this quantity of power some interesting additional installations have been made to the original Tokyo Electric Company's system, and to follow this development a brief history of the enterprise is necessary.

Starting in 1886 with a capital of Y.200,000, the business of

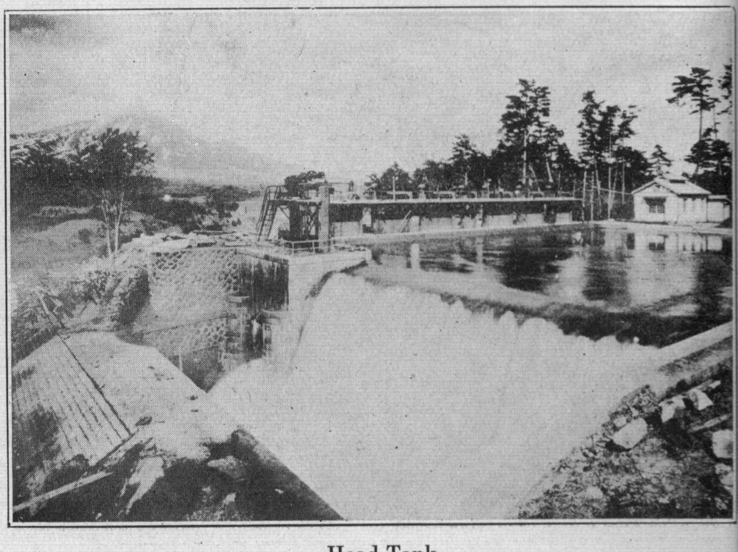


No. 1 Open Canal

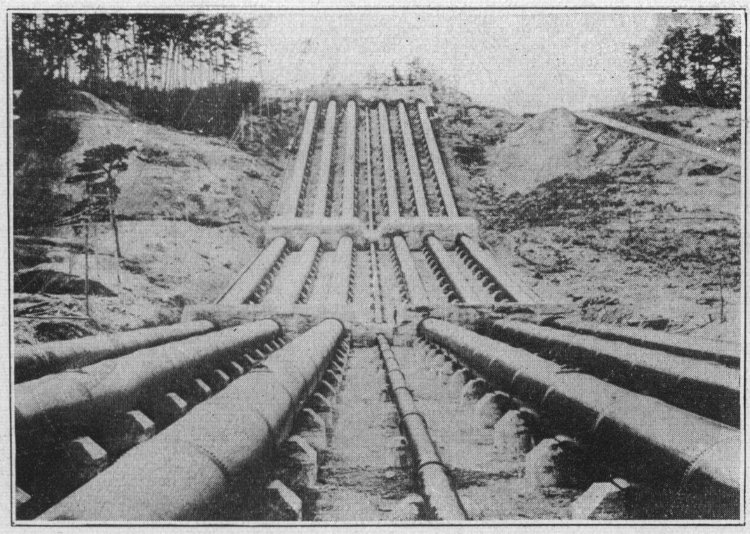
No. 1 Conduit



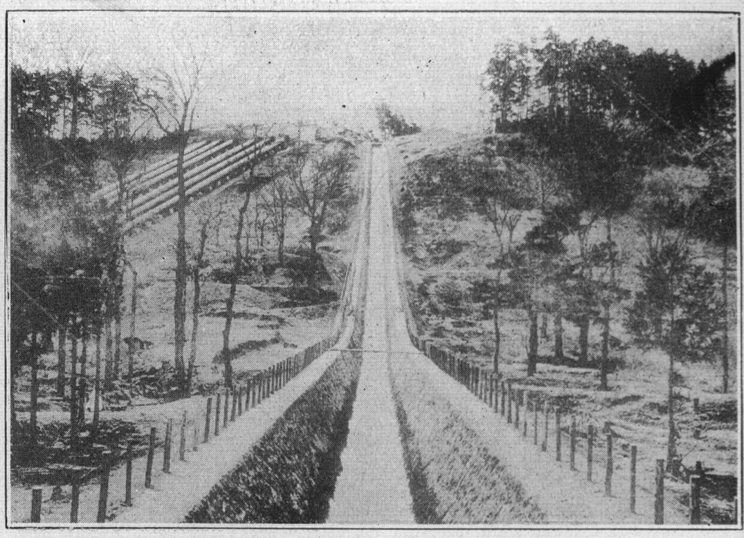
Nc, 1 Tunnel



Head Tank



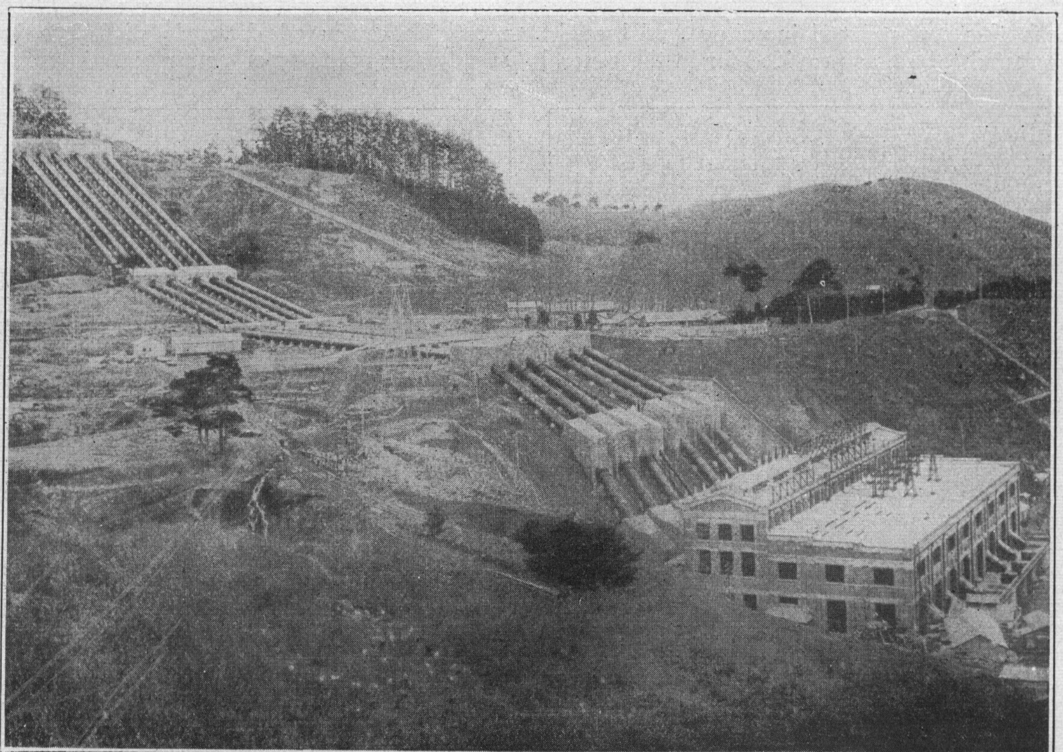
Pressure Pipe Lines for No. 1 Inawashiro Power House



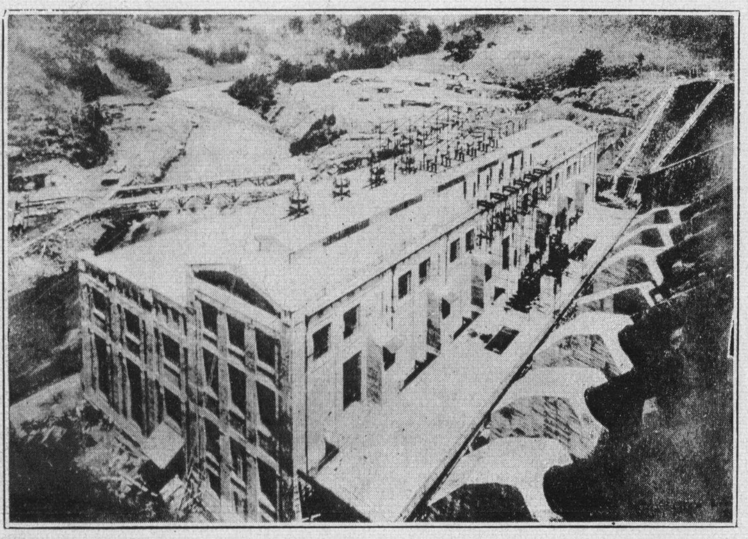
Spillway Canal

the company was largely confined to lighting the Imperial Palace, Government offices and a few stores and residences. The first installations were small steam plants driving direct current Edison generators. With the growth of the demand for lighting, the Tokyo Company amalgamated in 1890 with the Nippon Electric Light Company, and alternating current generators superseded the direct current installations. In 1908 a large steam station, equipped with five Westinghouse reaction type steam turbines, was placed in operation.

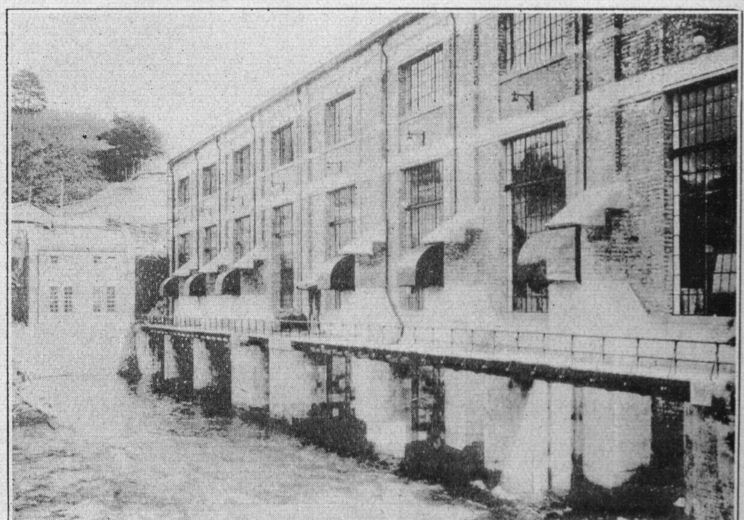
Various increases of capital were made until it reached Y.7,000,000 in October 1904, and during the next twenty years the Tokyo Electric purchased the rights and equipment of six competitors and amalgamated with twelve more, until at the present time it operates 32 power stations, 111 sub stations, 1,070 miles of aerial and 350 miles of underground transmission lines, nearly 5,000 miles of distributing mains, 49 miles of tramways and gas



No. 1 Inawashiro Power Station



Roof Installation of No. 1 Inawashiro Power House



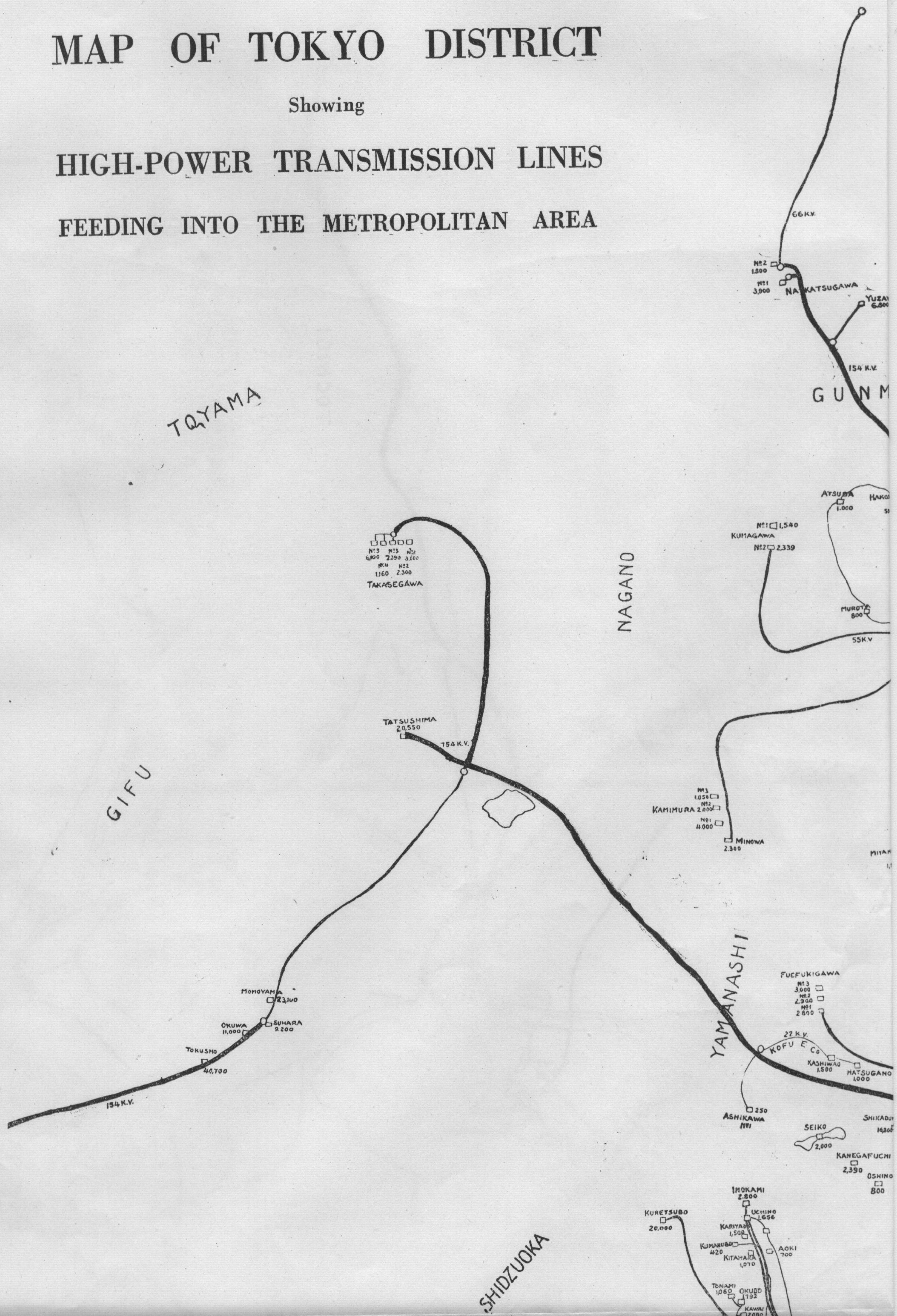
Tail Race of No. 1 Power House

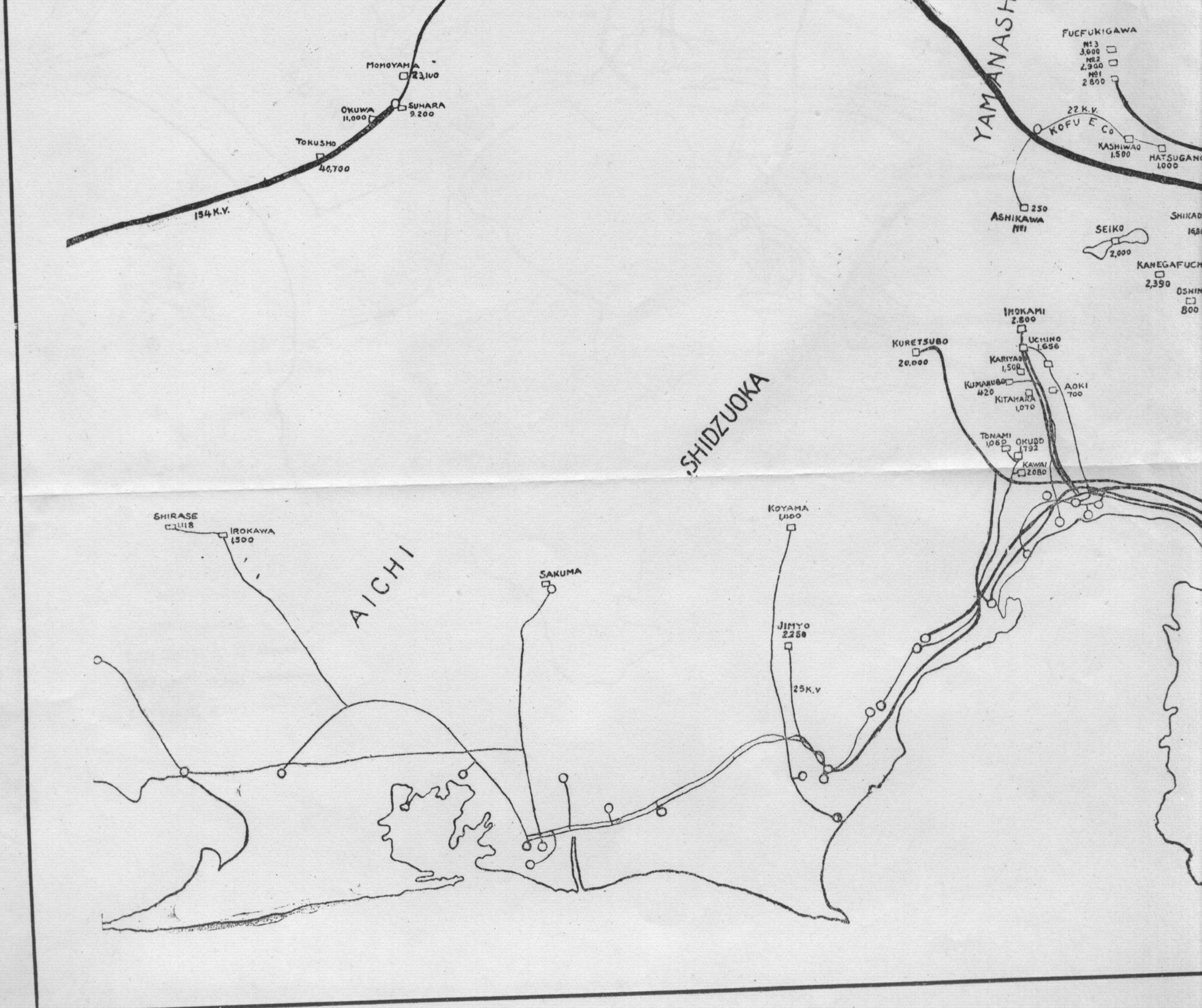
MAP OF TOKYO DISTRICT

Showing

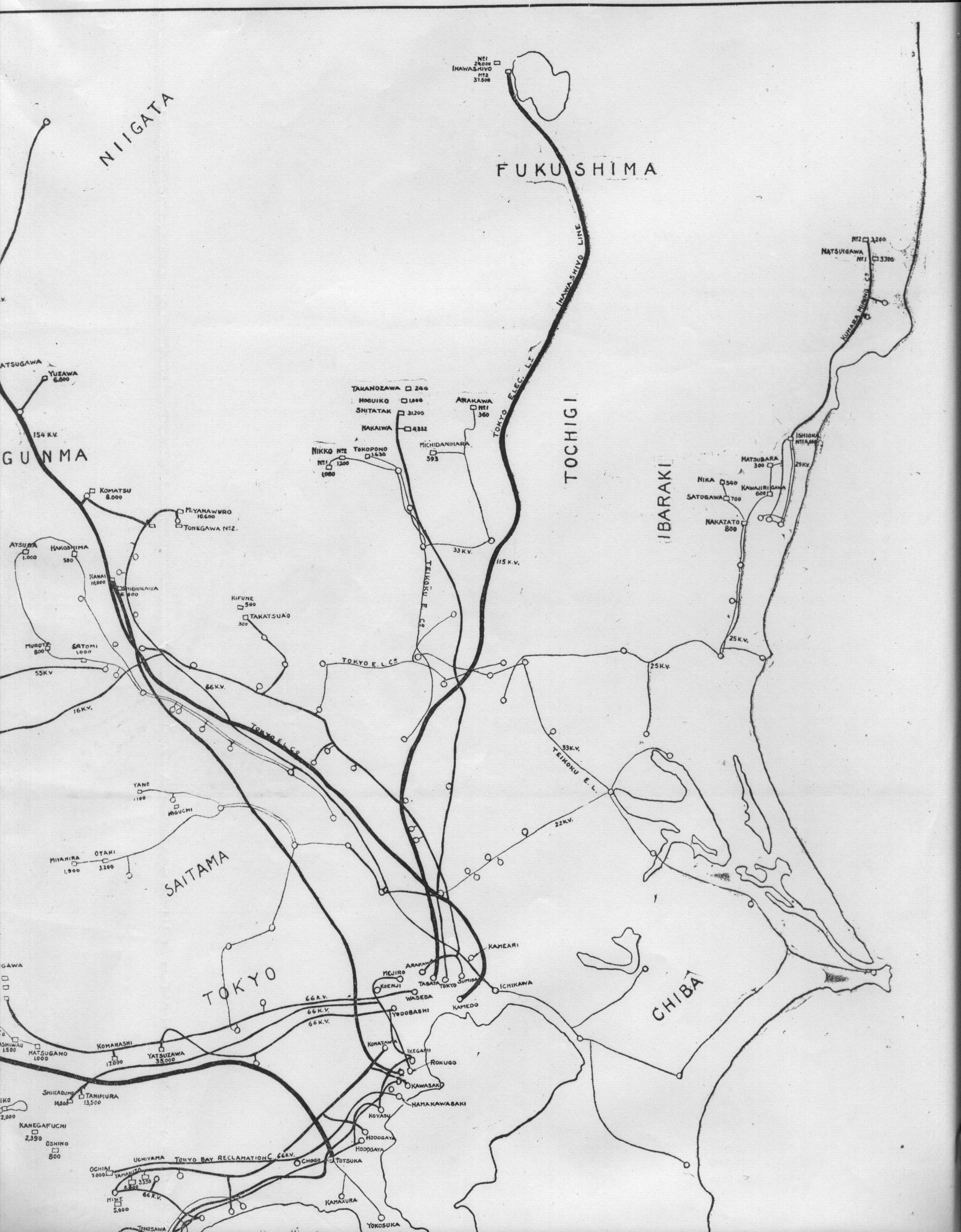
HIGH-POWER TRANSMISSION LINES

FEEDING INTO THE METROPOLITAN AREA

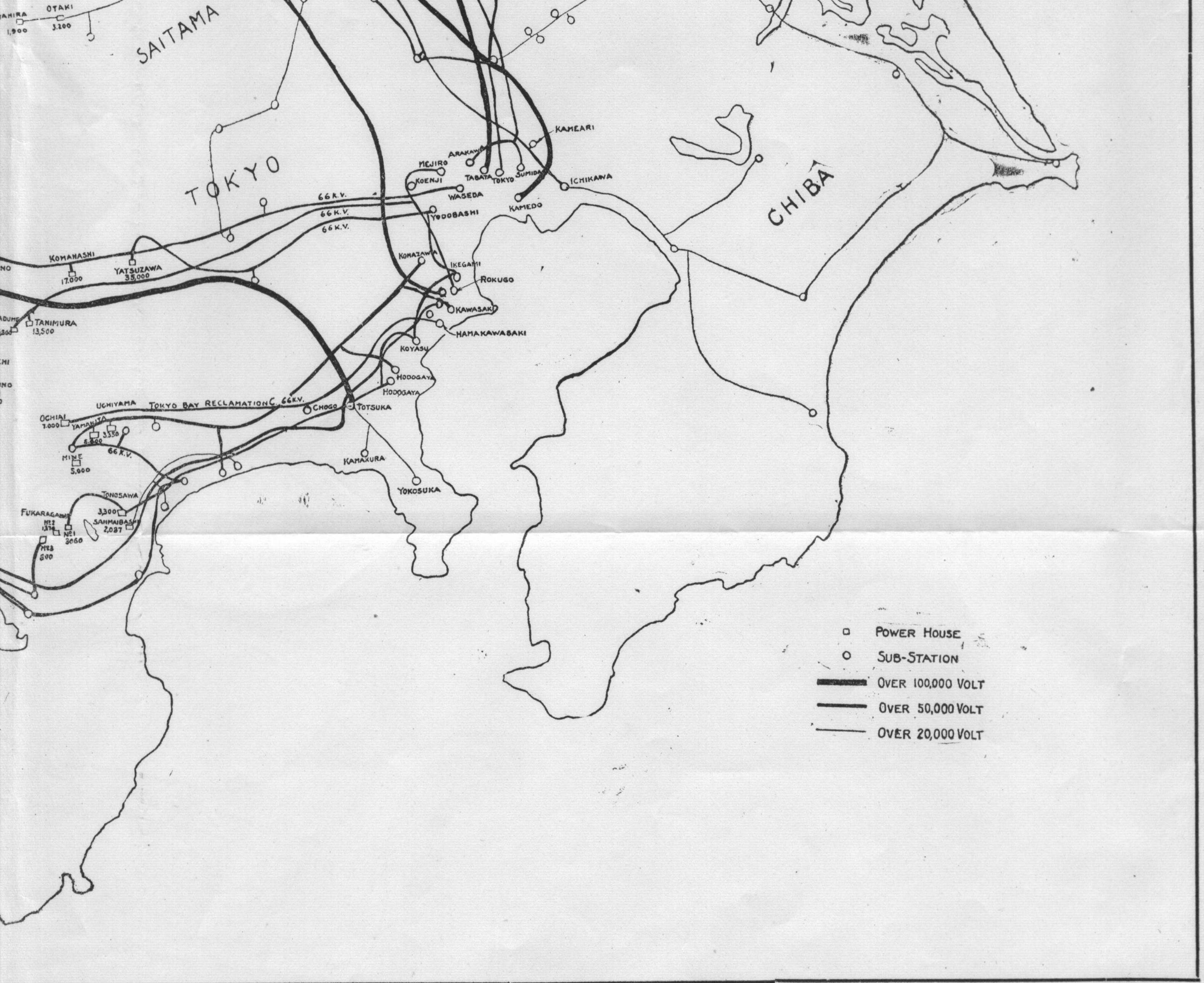




MOMOYAMA
23,100
SUHARA
9,200
OKUWA
11,000
TOKUSHO
40,700
154 K.V.
FUEFUKIGAWA
No. 3
3,000
No. 2
2,900
No. 1
2,800
22 K.V.
KOFU E Co
KASHIWAO
1,500
1,000
250
ASHIKAWA
No. 1
SEIKO
2,000
2,390
800
IMOKAMI
2,800
UCHINO
1,656
KURETSUBO
20,000
KARIYADO
1,500
KUMARUBO
420
KITAHARA
1,070
AOKI
700
TONAMI
1,060
OKUBO
792
KAWAI
2080
SHIDZUOKA
KOYAMA
1,500
SHIRASE
1,118
IROKAWA
1,500
AICHI
SAKUMA
JIMYO
2,250
25 K.V.



NIIGATA
FUKUSHIMA
GUNMA
TOCHIGI
IBARAKI
SAITAMA
TOKYO
CHIBA
No.1 24,000
INAWASHIVO
No.2 37,500
INAWASHIVO LINE
TOKYO ELEC. L.
TAKANOZAWA 240
HOSUIKO 1,000
SHITATAK 31,200
NAKAIWA 4,332
ARAKAWA No.1 360
MICHIDANIHARA 593
NIKKO No.2
No.1 1,080
1,200
TOKOPONO 1,630
33 K.V.
115 K.V.
TEIKOKU E. Co.
YUZAWA 6,500
154 K.V.
KOMATSU 8,000
M. YANAWURO 10,600
TONEGAWA No.2.
ATSUBA 1,000
HAKOSHIMA 580
KANAI 10,800
SHIBUKAWA
KIFUNE 560
TAKATSUAO 300
MUROTA 800
SATOMI 1,000
55 K.V.
16 K.V.
66 K.V.
TOKYO E.L. Co.
TOKYO E.L. Co.
25 K.V.
33 K.V.
TEIKOKU E.L.
22 K.V.
YANO 1,100
HIGUCHI
MIYAHIRA 1,900
OTAKI 3,200
No.2 3,200
NATSUIGAWA
No.1 3,700
KUHARA MINING Co.
ISHIOKA
29 K.V.
MATSUBARA 300
NIKA 540
KAWAJIRI GAWA 600
SATOGAWA 700
NAKAZATO 800
25 K.V.
KAMEARI
MEJIRO
ARAKAWA
KOENJI
TABATA
TOKYO
SUMIDA
ICHIKAWA
WASEDA
YODOBASHI
KAMEDO
66 K.V.
66 K.V.
66 K.V.
KOMAHASHI 17,000
YATSUZAWA 35,000
HATSUGANO 1,000
KOMAZAWA
IKEGAMI
ROKUGO
KAWASAKI
HAMAKAWASAKI
SHIKADUME 14,800
TANIMURA 13,500
KOYASU
HODOGAYA
HODOGAYA
KANEGAFUCHI 2,390
OSHINO 800
UCHIYAMA
TOKYO BAY RECLAMATION C. 66 K.V.
CHOGO
TOTSUKA
OCHIAI 7,000
YAMANITA
3,330
6,500
66 K.V.
MINE 5,000
KAMAKURA
YOKOSUKA
TONOSAWA



OTAKI
3,200
1,900
SAITAMA
TOKYO
CHIBA
KAMEARI
ARAKAWA
MEJIRO
KOENJI
TABATA
TOKYO
SUMIDA
ICHIKAWA
WASEDA
KAMEDO
YODOBASHI
66 K.V.
66 K.V.
66 K.V.
KOMAHASHI
17,000
YATSUZAWA
35,000
KOMAZAWA
IKEGAMI
ROKUGO
KAWASAKI
HAMAKAWASAKI
TANIMURA
13,500
KOYASU
HODOGAYA
HODOGAYA
UCHIYAMA
TOKYO BAY RECLAMATION C. 66 K.V.
CHOGO
TOTSUKA
OCHIAI
7,000
YAMAKITA
5,800
3,350
MINE
5,000
66 K.V.
KAMAKURA
YOKOSUKA
TONOSAWA
3,300
FUKARAGAWA
SANMAIBASHI
2,037
No. 1
3060
No. 3
800
POWER HOUSE
SUB-STATION
OVER 100,000 VOLT
OVER 50,000 VOLT
OVER 20,000 VOLT

works supplying 275,000 cubic feet per day to three towns in the Tokyo district. The expansion of the company is shown by the following table:

Year		Stock Capital. Yen	Remarks
July,	1886	200,000	Established
August,	1887	500,000	Increase of Capital
July,	1889	1,000,000	do.
January,	1890	1,300,000	Amalgamation of Nippon Electric Light Co.
March,	1891	875,000	Decrease of Capital
August,	1891	835,650	do.
December,	1893	1,000,000	Increase of Capital
November,	1895	2,000,000	do.
September,	1899	3,500,000	do.
August,	1902	3,500,000	Purchase of Shinagawa Electric Light Co.
October,	1904	7,000,000	Increase of Capital
September,	1905	7,150,000	Amalgamation of Fukagawa Electric Light Co.
January,	1906	7,150,000	Purchase of Hachioji Electric Light Co.
February,	1907	18,000,000	Increase of Capital
July,	1907	24,000,000	Amalgamation of Tokyo Electric Power Co.
May,	1911	50,000,000	Increase of Capital
January,	1917	50,000,000	Purchase of Edogawa Electric Company
August,	1919	100,000,000	Increase of Capital
March,	1920	124,000,000	Amalgamation of Nippon Electric Light
April,	1921	146,000,000	Amalgamation of Tone Generating Co.
April,	1921	146,000,000	Purchase of Tone Tramway Company
May,	1921	166,000,000	Amalgamation of Yokohama Electric Co.
October,	1921	171,000,000	Purchase of Second Toshin Electric Co.
December,	1921	177,250,000	Amalgamation of Takasaki Hydro-Electric Power Company and Kumakawa Electric Co.
February,	1922	219,750,000	Amalgamation of Katsuragawa E. P. Co.
October,	1922	222,000,000	Amalgamation of Nippon Hydro-Electric Power Company
November,	1922	222,000,000	Purchase of Karasugawa Electric Power Co.
February,	1923	222,000,000	Purchase of Minakami Generating Co.
April,	1923	258,000,000	Amalgamation of Inawashiro H. E. P. Co. and Oshino Hydro-Electric Power Co.

The fixed policy of the company to maintain the lead in its own field was at all times justified by its earnings, which for years enabled it to declare an average dividend of ten per cent., fourteen per cent. for the two years prior to the earthquake, and eight per cent. for the latter half of 1923. The demand for light and power has steadily grown from 42,233 lamps and output of 30 k.w. of power demand in 1899 to 3,848,407 lamps and 286,520 k.w. gross output power demand at the end of 1924. During the last five-year period (1919-24) the total energy generated (including purchased power) increased from 422,000,000 k.w.h. to 1,350,289,700 k.w.h., the rated output of the 30 hydro-electric stations being 212,407 k.w. and 16,200 k.w. for the two steam plants. An additional 131,160 k.w. was purchased from other companies, making a grand total output at the end of 1924 of 359,767 k.w. The following list gives the names and particulars of the company's various power stations:

Water Power Stations.

Rivers	Power Stations	Effective Head	Rated Output	Generators Unit	Generators No.	Transformers Unit	Transformers No.
		Feet	K.W.	K.V.A.		K.V.A.	
Nippashi:	Inawashiro No. 1 ...	352	37,500	7,777	6	4,400	12
	Inawashiro No. 2 ...	229	24,000	6,666	5	4,400	6
Tone:	Atsuta	272	1,000	750	2	600	4
	Hakoshima	300	300	300	1	250 150	3 1
	Iwamuro	524	10,800	6,000	3	2,000	7
	Kamikuya No. 1 ...	360	2,400	600	4	800	4
	*Kamikuya No. 2 ...	383	13,500	6,660	3	6,700	4
	Kifune	51	500	500	1	—	—
	Komatsu	375	10,633	4,800	4	4,800	4
	Kumakawa No. 1 ...	465	2,339	3,000	1	1,500	3
	Kumakawa No. 2 ...	295	1,540	2,000	1	—	—
	Nurukawa	58	255	375	1	—	—
	Satomi	158	1,000	1,250	1	450	3
	Takatsudo	26	300	350	1	—	—
Shinano:	Domura No. 1 ...	233	4,000	2,200	3	3,350	4
	Domura No. 2 ...	80	2,000	2,500	1	—	—
	Domura No. 3 ...	37	1,050	1,450	1	—	—
	Minowa	210	2,300	2,875	2	1,900	4
	Yuzawa	991	6,500	4,375	2	4,800	2
			*7,500	4,375	2	—	—
Katsura:	Kanegafuchi... ...	380	2,390	3,500	1	—	—
	Komahashi	345	17,000	3,900	6	2,000	11
	Oshino	131	800	1,000	1	—	—
	Saiko	210	2,000	2,500	1	—	—
	Shishidome	470	16,800	7,000	4	3,500	9
	Yamura	374	13,500	6,000	4	3,000	9
	Yatsuzawa	389	35,000	7,700	6	4,000	12
Fuefuki:	Fuefuki No. 1 ...	342	2,900	3,000	1	3,000	4
	Fuefuki No. 2 ...	490	2,900	3,000	1	—	—
	Fuefuki No. 3 ...	716	3,000	3,300	1	—	—
Haya:	Tonosawa	700	3,300	2,000	2	750	7

*Under construction.

Steam Power Stations.

Power Stations	Rated Output	Generators Unit	Generators No.
	K.W.	K.V.A.	
Asakusa	4,000 (old)	2,000	3
Asakusa	*50,000 (new)	25,000	2
Enoshima	225	75 150	1 1
Kanagawa	14,500	3,750 7,500 3,000	2 1 1
Wakamatsucho	1,700	850	2

*Under construction; old machinery, except 6 boiler units, removed to Kanagawa.

The chief damage to the plants of the company caused by the earthquake was confined largely to the buildings and power canals of eleven stations with an output aggregating 109,000 k.w. An outline of the damage is given in the following list:

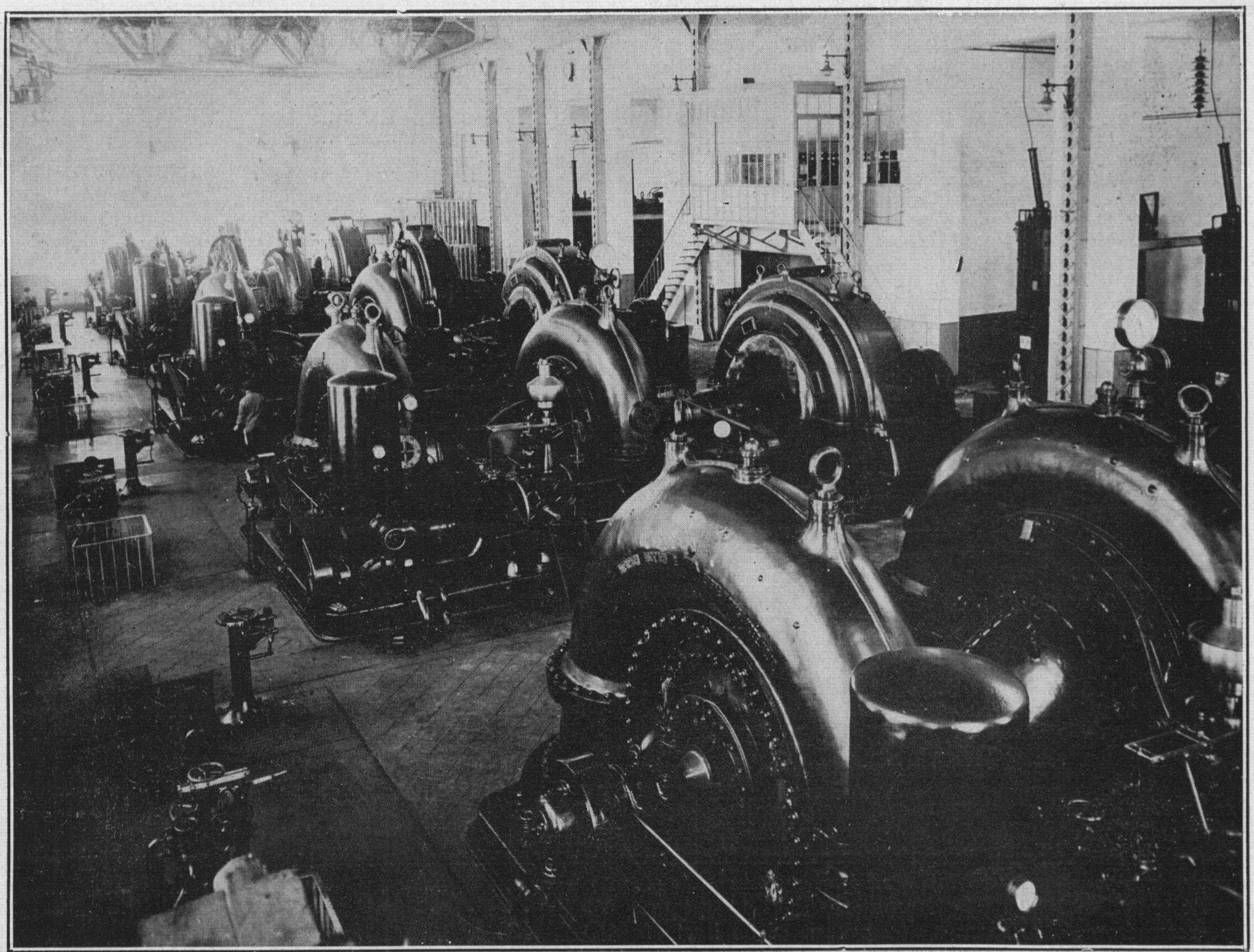
List of Damaged Power Stations.

Motive Power	Power Stations	Output. K.W.	Canals	Penstocks	Machineries	Buildings
Water:	Kanegafuchi	2,390	Slightly cracked	All right	All right	Slightly cracked
	Komahashi	17,000	Partly filled with sand	do.	do.	do.
	Oshino	800	Seriously damaged	do.	do.	Cracked
	Shishidome	16,800	Cracked and partly filled with sand	do.	do.	Partly collapsed
	Yamura	13,500	Cracks in the tunnel	do.	do.	Slightly cracked
	*Yatsusawa	35,000	All right	Crack in foundations ...	do.	All right
	Tonosawa	3,300	Partly collapsed and filled with sand	Rivetting injured ...	do.	Seriously cracked
Steam:	Asakusa (old)	4,000	—	—	do.	Collapsed and burned
	Enoshima	225	—	—	do.	Collapsed
	Kanagawa	14,500	—	—	do. except sw. apparatus	Partly collapsed
	Wakamatsucho	1,700	—	—	All right	Slightly cracked

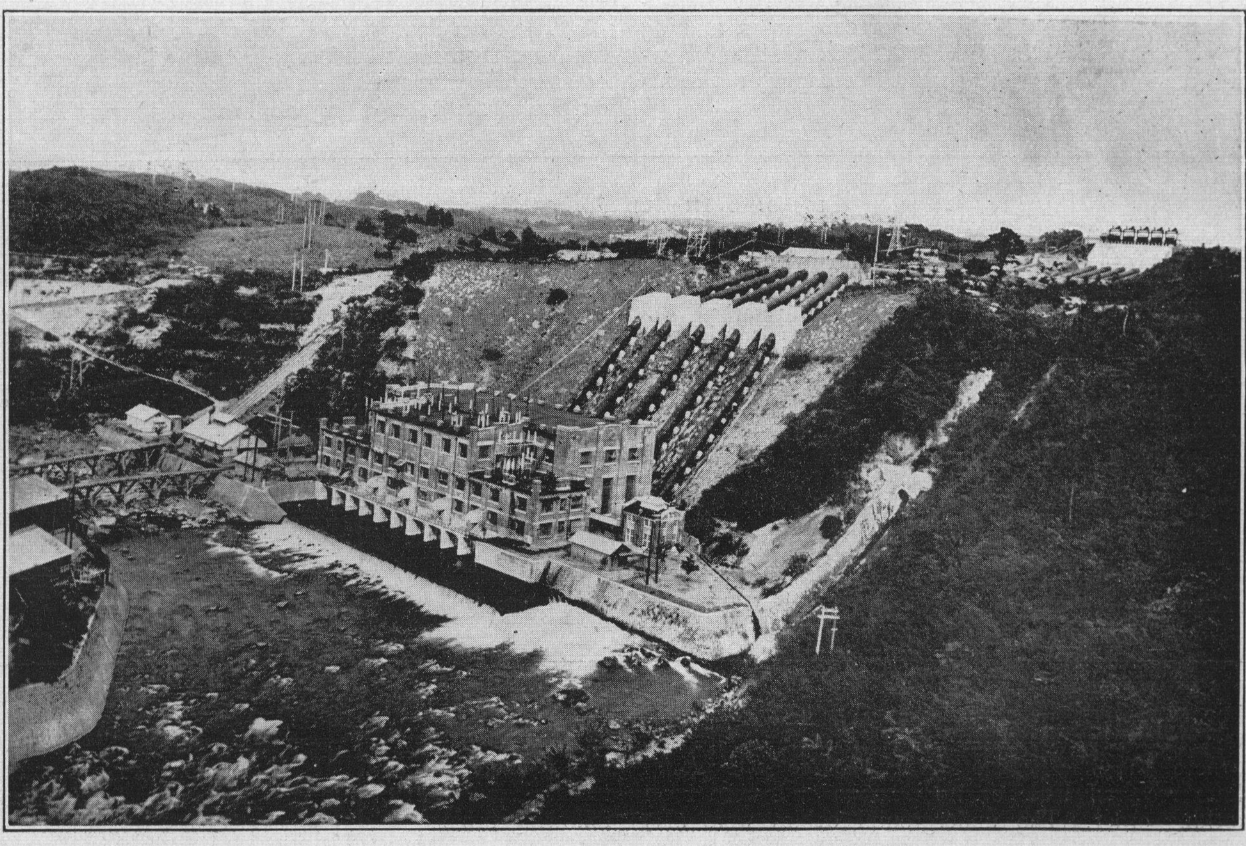
*—Dam of Ohno reservoir cracked; crack in the head tank enlarged.

At the time of the earthquake the company owned 1,070 miles of aerial transmission lines, and except for a few towers in localities where the shocks were very severe the aerial transmission lines received little or no damage and were soon restored to working order. The underground cables were also intact, except in those exposed parts strung on bridges. Complete recovery was made soon after the disaster, and at the present time the high tension aerial and underground transmission lines of the company total 1,541 miles, as per the following table:

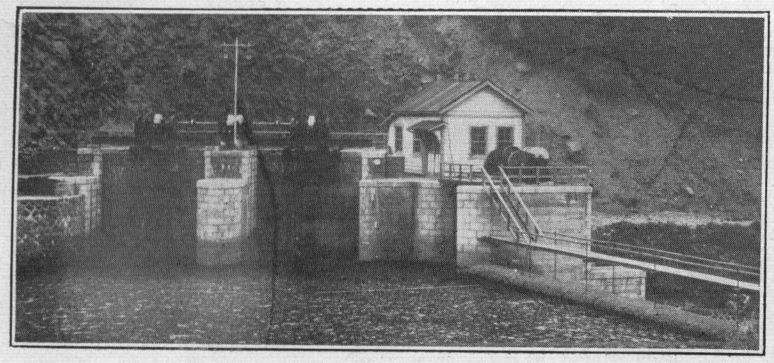
A POWER HOUSE EQUIPPED THROUGHOUT WITH JAPANESE MANUFACTURED MACHINERY.

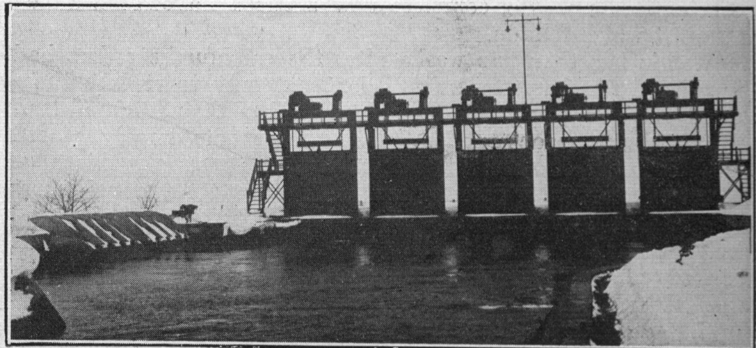


General View of Interior of No. 2 Inawashiro Power Station, Equipped throughout with Japanese Manufactured Machinery; Five Penstocks from the Tokyo Ishikawajima Shipbuilding Co., Five 6,666 k.v.a. Shibaura Cenerators operated by Five 10,250 h.p. Horizontal Twin Spiral Francis Turbines made at the Kobe Works of the Mitsubishi Dockyard and Shipbuilding Company; Six 115,000 volt, 4,400 k.v.a. Shibaura Transformers.



General View of No. 2 Inawashiro Power House: Head 230 feet.





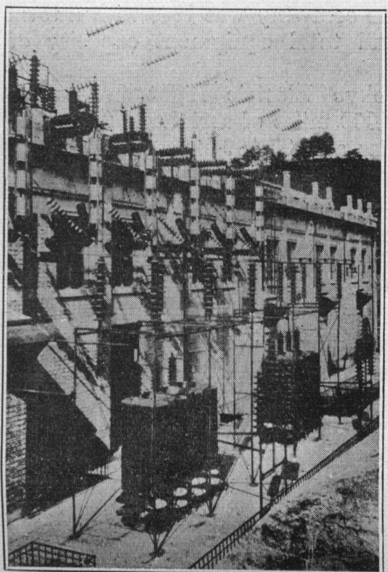
Inawashiro No. 2 Power House

Intake Gate House

Head Tank

LIST OF AERIAL TRANSMISSION LINES (Above 20,000 Volts)

Systems	Divisions Included in the System	Voltage	Length	No. of Circuits	Size of Conductors	Poles or Towers
		Volts	Miles		Circular Mils:	
Inawashiro	Inawashiro	115,000	141.3	2	197,600	Steel Tower
Joetsu	Joetsu	154,000	125.3	2	500,000 and 385,000	do.
	Joetsu Tie Line	66,000	4.2	2	114,700	Wooden Pole
	Komatsu...	154,000	4.6	2	205,500	Steel Tower
	Nagaoka	66,000	36.8	1	124,700	Steel Pole
	Yuzawa	66,000	6.8	2	200,000	Steel Tower
Maebashi (old)... ...	Arakawa	66,000	4.1	2	98,500	do.
	Fuji Paper Mfg. Co. Line ...	66,000	2.4	1	72,700	Wooden Pole
	Ashikaga...	66,000	5.0	1	98,500 and 41,600	do.
	Gyoda	66,000	5.9	1	41,600	do.
	Ichikawa...	66,000	6.0	2	205,500 and 59,200	Steel Tower
	Iwamuro...	66,000	28.9	2	98,500	do.
	Kameari	66,000	1.4	2	114,700	Wooden Pole
	Kiryu	66,000	8.0	1	44,800	do.
	Oana	66,000	13.8	1	41,600	do.
	Maebashi (old)	66,000	70.2	2	205,500 and 98,500	Steel Tower
	Sumida	66,000	4.6	2	205,500 and 171,500	do.
Maebashi (new) ...	Maebashi (new)	66,000	56.1	2	205,500 and 72,660	Wooden Pole
Takasaki	Takasaki	22,000	113.5	1 or 2	83,200 and 41,600	do.
Kumakawa	Kumakawa	55,000	37.6	1	114,700 and 91,000	do.
Toshin	Toshin	66,000	54.0	1 or 2	205,500 and 124,700	do.
Tochigi	Tochigi	22,000	34.7	1	59,200 and 41,600	do.
Ibaragi	Ibaragi	22,000	37.7	1	59,200	do.
Komahashi	Fuefuki	55,000	22.4	2	72,800	do.
	Komahashi	55,000	47.4	2	198,500	do.
Yatsuzawa	Yatsuzawa	55,000	38.9	4	198,500	do.
Yamura	Rokugo	77,000	10.9	2	131,400	Steel Tower
	Yamura	77,000	53.6	2	213,900	do.
Koyasu...	Sobu	66,000	20.2	2	197,300 and 100,800	Wooden Pole
	Sakaigi	66,000	5.9	2	197,700	Steel Tower
	Hodogaya	66,000	6.0	2	from 259,200 to 107,700	do.
Hakone	Hakone-Mine	66,000	39.2	2	from 242,500 to 152,400	do.
	Kamakura-Yokosuka	66,000	14.4	2	from 197,700 to 70,400	do.
	Fukara	66,000	12.2	2	72,700	do.
Keihin	Takasegawa	154,000	31.8	2	400,000	do.
	Total		1,105.8 Miles			



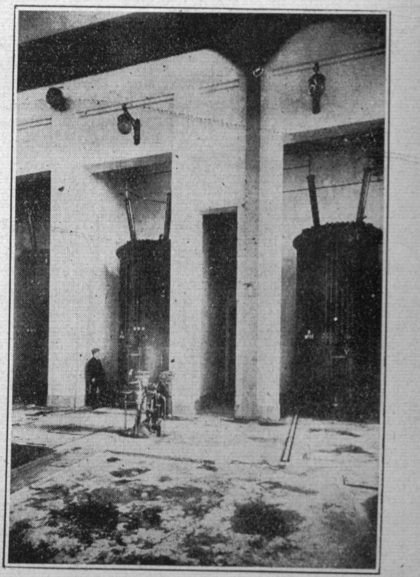
High Tension Lightning Arresters

Total length of the high tension transmission lines, both aerial and underground, owned by the company at the end of this term is classified according to voltages as follows:

Aerial lines—154,000 Volts, 161.7 Miles; 115,000 Volts, 141.3 Miles; 77,000 Volts, 64.5 Miles; 66,000 Volts, 406.1 Miles; 55,000 Volts, 146.3 Miles; 22,000 Volts, 185.9 Miles; Underground lines:— 22,000 Volts and 11,000 Volts, *436.0 Miles. Grand total, 1,541.8 Miles.

*This figure alone is counted in circuit miles.

At the time of the earthquake, the company owned and operated 111 sub-stations with a total output of 740,000 k.w., the aggregate equipment capacity being about 999,000 k.v.a. Thirty-seven of these stations, having an aggregate capacity of 220,480 k.w., were damaged, though this was confined largely to the buildings. Over 39,450 k.w. capacity of transformers, 9,980 k.w. of motor generators and 4,000 k.w. of synchronous condensers were damaged. Repairs were, however, speedily executed, some of the stations having their capacity altered according to the local changes in demand, while three stations in districts awaiting settlement of the land adjustment scheme



Main Transformers

are being held up. Six complete new stations have been added to the list which follows.

Within less than two weeks after the earthquake orders had been placed for transformers sufficient not only to replace those burned, but also to provide for a large part of the additional load anticipated for reconstruction. Dependence was largely placed on the capacity of American manufacturers to supply this huge amount of material. Distribution and power type transformers to the total of 185,000 k.v.a. capacity were ordered from the General Electric Co., U.S.A., and initial shipment on an emergency basis was made on October 13th by this company.

LIST OF SUB-STATIONS OF TOKYO ELECTRIC LIGHT CO.

Sub-stations	Output. K.W.	Equipment. K.V.A.
Akabane	3,000	4,500
Aoyama	3,000	4,000
Arakawa	9,000	12,000
Asakusa	3,000	3,500
Ashikaga...	3,300	4,100
Asukayama	4,500	6,000
Azabu	4,500	5,500
*Eirakucho	300	450
Fukagawa	5,400	6,300
Fukaya	900	1,050
Funakoshi	2,644	3,500
Gokurakuji	200	200
Hachioji	4,730	7,000
Hanyu	300	400
Hashiba	3,300	4,400
Hayashicho	4,800	5,600
Higashimachi	3,000	3,750
Hikawa	3,000	4,000
Hikifune	6,000	7,000
Hodogaya	27,750	35,500
Hongincho	D.C. 2,500	D.C. 2,500
Hongo	2,250	3,000
Honjo	4,500	5,500
Honsho	1,200	1,200
Ichikawa...	6,000	8,000
Ichinomiya	600	800
Ikegami	4,500	6,000
Isezaki	1,500	2,000
Itabashi	3,000	4,000
Iwamoto	D.C. 130	D.C. 205
Jujo	2,400	3,200
Kamakura	1,500	2,000
Kameari	10,200	12,900
Kameido	33,400	90,000
Kanda	3,000	3,500
	D.C. 1,500	D.C. 1,920
Kawadacho*	3,000	4,000
Kayatsuki*	42,000	49,000
Kiryu	2,250	2,700
Kobikicho	D.C. 1,500	D.C. 1,500
Koenji	1,500	2,000
Kobinata	150	150
Koishikawa	2,400	2,800
Kojimachi	2,000	2,500
	DC. 850	D.C. 1,000
Komatsu...	63,000	84,000
Koyasu	15,000	25,600
Kubocho	2,250	3,000
Kumagaya	1,200	1,600
Kuragano	900	1,050
Kurobo	300	400
Kyobashi	4,500	5,250
	D.C. 1,640	D.C. 2,140
Maebashi...	1,500	1,750
Marunouchi	6,600	8,800
Matsubacho	3,600	4,400
Matsuda	256	340
Mejiro	30,000	40,000
Mibu	180	210
Minamisayacho	D.C. 2,500	D.C. 2,500
Minamiyoshida	3,000	3,750
Mine	6,000	7,000
Munetaka	450	450
	D.C. 300	D.C. 300
Nagaoka	9,000	12,000
*Nakatsugawa No. 1	43,500	58,000
Nakatsugawa No. 2	20,100	26,800
Namie	4,950	4,950
Negishi	3,000	4,500
Nenokamiyama	3,000	4,000
Nihonbashi	3,000	3,500
	D.C. 1,760	D.C. 2,260
Noda	600	600
Numata	300	350
Oi...	3,600	4,800
Oji	7,800	10,800
Okegawa	450	600
Omama	225	225
Orihara	450	450
	D.C. 270	D.C. 270
Osagami	2,250	2,600
Osaki	3,000	4,000
Oshima	15,000	17,500
Ota	900	1,500
Oyama	600	800
Rokugo	17,000	26,000
Sakuragicho	3,750	4,500
Samoncho	2,250	3,000
Ohno	1,500	2,000
Satte	600	800
Senju	4,800	6,000
Shin-izumicho	D.C. 2,500	D.C. 2,500
Shinmachi	360	360
Shin-ogawamachi	2,250	3,000
Shitaya	4,500	6,000
Sumida	12,000	16,000
Tabata	48,000	56,000
Tachikawa	3,750	5,000
Taguchi	150	200
	D.C. 100	D.C. 100
Tajima	450	600
Tajimacho	2,750	3,500
	D.C. 100	D.C. 150
Takanawa	3,000	3,750
Takasaki	7,200	8,400
Takasegawa	30,000	40,000
Taru	150	150
Tatebayashi	4,650	5,800
Tokiwacho	3,860	5,000
	D.C. 130	D.C. 260
Toshimacho	2,250	3,000
Tsurumi	3,000	4,000
Umego	600	600
Uraga	2,366	2,755
Waseda	16,200	23,800
Yanagishima	6,000	7,200
Yodobashi	34,400	45,950
Yokosuka	15,000	20,000
Yoshiwara	900	1,050
*Zushi	4,550	7,000
Total	A.C. 600,171	829,990
	*118,500	*151,000
	D.C. 15,780	17,605
Grand Total	734,451	998,595

*Converted to Switching Station.

The six new installations mentioned above are as follows :—

Sub-stations	Rated Output. K.W.	Equipment Capacity. K.V.A.	Remarks
Hashimoto	51,000	68,000	New installation
Kawadacho	3,000	4,000	do.
Nishiarai	6,000	8,000	do.
Nakatsugawa No. 1 ...	22,100	58,000	do.
Senzoku	30,000	40,000	do.
Takasegawa	14,440	40,000	do.

At the end of 1924 the total number and output of the serviceable sub-stations owned by the company was 108, with a total rated output of 809,941 k.w., and total equipment capacity of 1,111,060 k.v.a.

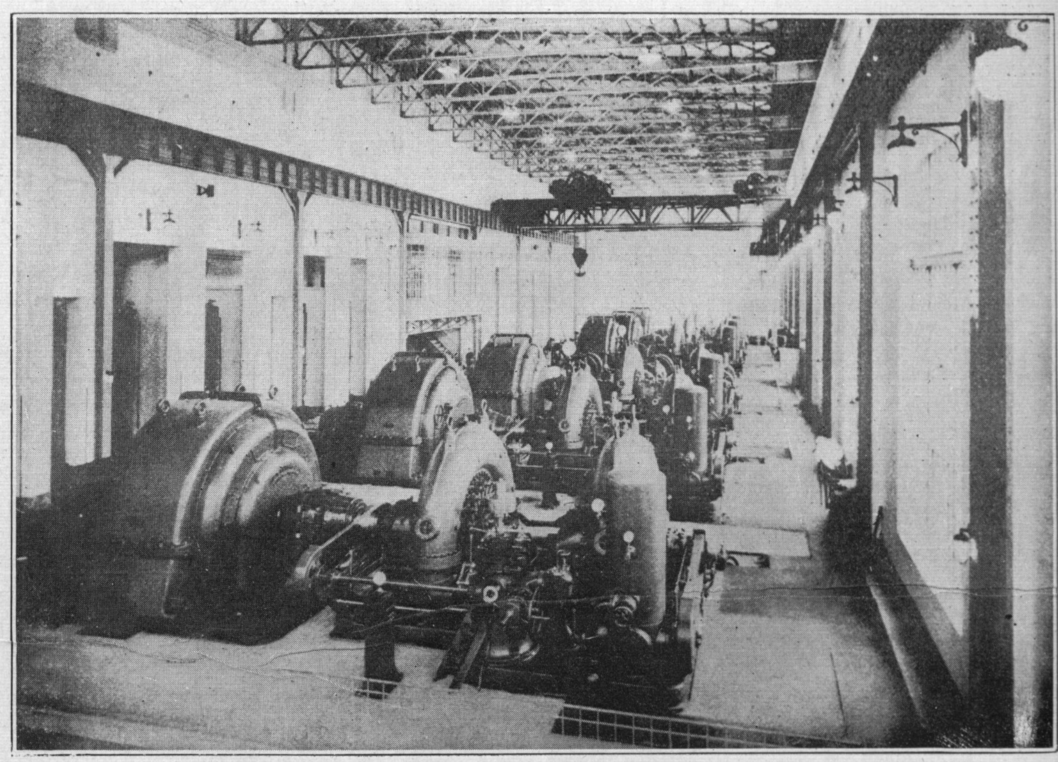
Before the disaster the Tokyo Electric Light Company's distribution system consisted of 4,660 miles of aerial and 260 miles of underground lines, 175,000 poles and 35,600 pole transformers. The damages to these distributing lines covered 570 miles of line with 27,200 poles and 10,300 pole transformers burnt. By the end of last year the distribution capacity of the company had been almost completely restored. Lines have been extended and pole transformers increased to the extent that the distribution capacity as a whole has been greatly enlarged. The distribution system at the end of last year is as follows :—

Locality	Length of Aerial Lines Miles	Number of Poles	Number of Pole Transformers	Length of Underground Lines Miles
Tokyo and Vicinity ...	1,677.00	75,838	24,273	269.01
Yokohama and Vicinity	728.24	32,132	5,351	5,26
Maebashi, Takasaki and Vicinity ...	2,538.89	79,988	8,544	4,42
Total	4,944.13	187,958	38,168	278.69

The light and power equipment of the company prior to the quake consisted of 4,356,500 lamps, 120,700 h.p. motor load connected and 155,700 k.w. of other power loads. The approximate damages to this equipment consisted in a loss of 554,200 lamps owned by consumers, 1,489,500 owned by the company, and a gross loss of motor and other connected power equipment of 102,000 k.w. Practically no damage was sustained by the motor and power equipment owned by the company, although 35,000 watt meters were burnt.

The Tokyo Electric Light Company operates $42\frac{1}{2}$ miles of tramways at Maebashi and $6\frac{1}{2}$ miles at Kamakura. The intensity of the seismic disturbance in the Kamakura district resulted in slight damages to the line between that town and Fujisawa, some parts of the permanent way being twisted or buried under fallen ground and part of a tunnel entrance destroyed. The repairs to this line were completed within twenty days.

The company also operates gas plants at Maebashi, Takasaki and Yokosuka, with a supply capacity of 25,000, 50,000 and 200,000 cubic feet per day respectively. The Yokosuka plant suffered severely as a result of the quake, but was temporarily repaired and brought into operation within three weeks.



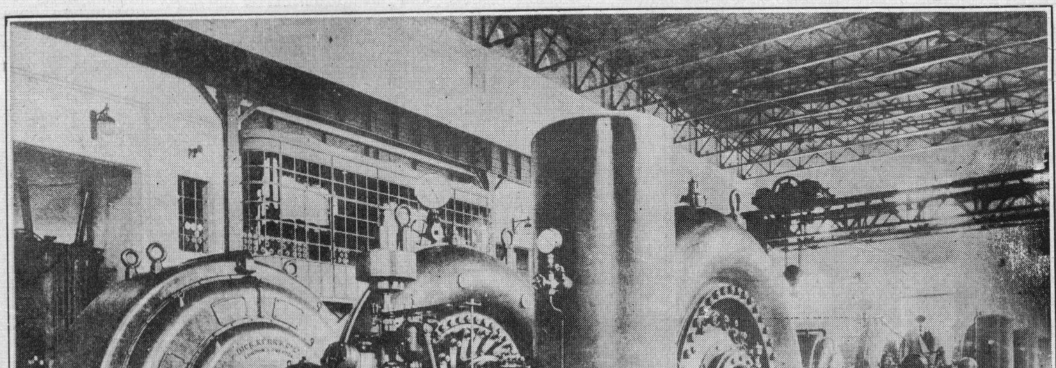
General View of Generating Room, No. 1 Inawashiro Power House; Equipped with Six 7,000 k.w. Dick, Kerr & Company (English Electric) Alternators driven by Six 11,250 h.p. J. M. Voith Horizontal Francis Double Spiral Water Turbines.

The approximate value of the damages to the various properties of the company are bulked as follows :

Distributing lines, light and power equipment ...	Y.10,994,726
Power stations, sub-stations and transmission lines...	3,247,276
Materials in stock and utensils	3,073,598
Gas supply and tramway equipment	144,068
Buildings and tools	2,794,011
Water-power Canals	308,539
Miscellaneous	84,771
Total	Y.24,646,989

In addition to this material loss, 41 employees connected with the Tokyo Head Office and 80 attached to the Yokohama branch (a total of 121) were killed.

The disaster called forth immediate and almost superhuman efforts to restore light and power to the stricken areas, and it is a high tribute to the character and organization of the company that all hands bent to the task of meeting the emergency in order to save the city from a further calamity arising from the complete paralyzation of all public utilities. Two days after the earthquake the electric motor driven hydraulic pump of the city waterworks was supplying water to a part of the metropolis, customers in the vicinity of the sub stations connected up, and the army radio station at Nakano placed in operation. Power was supplied as quickly as possible to rice mills, newspapers and other essential small industries, and steet lighting turned on as quickly as the distributing lines were restored. In short, the very effective co-operation and strenuous work on the part of the organization brought such a rapid recovery that by the end of the year the total actual power output of the company amounted to about the same as it was before the catastrophe. By the end of last year the effect of the earthquake on the company was equivalent to about the loss of one year's normal increase in the demand. But even this was merely temporary, as the lessons taught by the disaster resulted in an increased demand for electric power by those concerns which formerly used steam, gas or other prime movers in their factories. The catastrophe also emphasized the necessity for the electrification of the steam railways, a wider application of electricty in the home, and for many industrial purposes where direct heat had formerly been employed.



No. 1 Inawashiro Power Station; Dick, Kerr (English Electric Co.) and Voith Water Turbine, Generating Set.

In order to meet this vigorous demand for power the Tokyo Electric Light Company started another construction program involving the erection

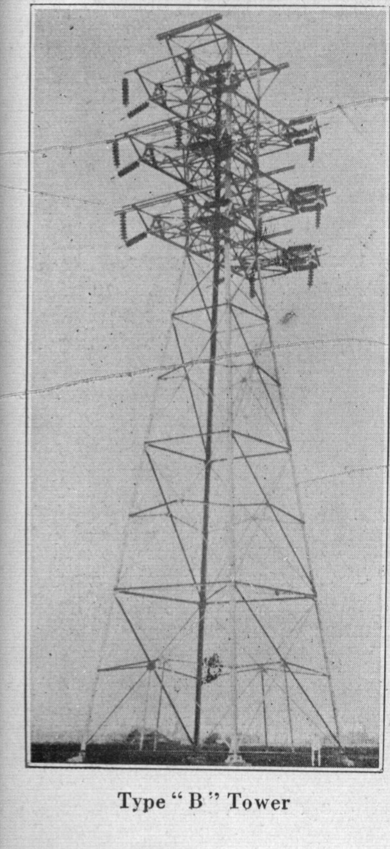
of the No. 3 (20,700 k.v.a.), and No. 4 (32,100 k.v.a.) Inawashiro water power plants, a new Inawashiro transmission line and a 50,000 k.w. steam plant at Senju. The old steam plants at Asakusa and Enoshima have been abandoned.

The new construction program is a sequel to the original Inawashiro development initiated in 1912 by Dr. Sengoku (now Minister of Railways), at that time president of the Inawashiro Power Company. The source of water supply is Lake Inawashiro, an ideal storage reservoir situated at an elevation of 1,700-ft. above sea level, 145 miles north of Tokyo, covering nearly 42 square miles of drainage area with a storage capacity of 3,500,000 cubic feet. The development of this source of power was undertaken by the Inawashiro Hydro-Electric Company, organized for the purpose by the Mitsubishi interests, who erected the first and second Inawashiro hydro-electric power stations that were subsequently absorbed into the Tokyo electric system when the two companies amalgamated in April 1923.

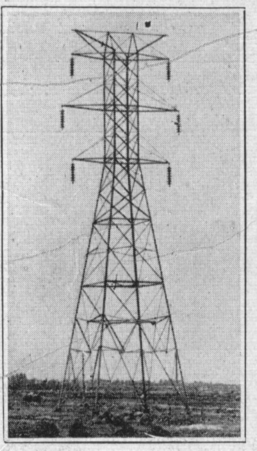
The new extension scheme calls for the construction of two additional stations deriving power from the Nippashi river. The great power demand necessitated increasing the voltage from 115,000 to 154,000 and quadrupling the volume of the giant switches. The new No. 3 plant will have three General Electric 6,900 k.v.a., and No. 4 plant three General Electric 10,700 k.v.a. vertical generators. To ensure the maximum efficiency of the water power supply a new steam station is also being erected at Senju, near Tokyo, in which two 25,000 k.w. Westinghouse turbo-alternators are being installed.

The original No. 1 and No. 2 Inawashiro generating stations received their power from the Nippashi river, the intake for No. 1 being placed at about 5,580-ft. down stream from its outlet at Lake Inawashiro. The length of the power canal is about 7,290-ft., consisting of two tunnels, four open canals, five conduits and two aqueducts. There are six (one spare) main pressure pipe lines with an inner diameter of 7-ft., and one exciter pipe line under an effective head of 352.4-ft. The water from the tail race discharges direct into the Nippashi river. The grade of the canal varies from 1-1,500 to 1-2,000-ft.

The generating plant of the No. 1 Inawashiro power house consists of six (one spare) J. M. Voith horizontal type double spiral Francis turbines, with a capacity of 11,250 h.p. each, operating at 375 r.p.m., with an effective head of 104 meters. These are connected to six Dick, Kerr & Company (English Electric Company) enclosed forced draught horizontal shaft alternating current generators of 7,000 k.w., power factor 90, three phase, 6,600 volts, 50 cycles, 375 r.p.m. The four direct current exciters have a 200 k.w. capacity each, 250 volts, 500 r.p.m., and are operated by J. M. Voith horizontal impulse turbines of 492 h.p. each, at full gate opening, with an effective head of 98 meters. The twelve main transformers from the Westinghouse Electric & Manufacturing Company are single phase, 50 cycles, 4,400 k.v.a. capacity, with 115,000 volts on the high tension side and 6,600 volts on the low. They are delta connected in both high and low tension sides, and oil cooled. The switching apparatus and switch boards were also supplied by the same company.



Type "B" Tower



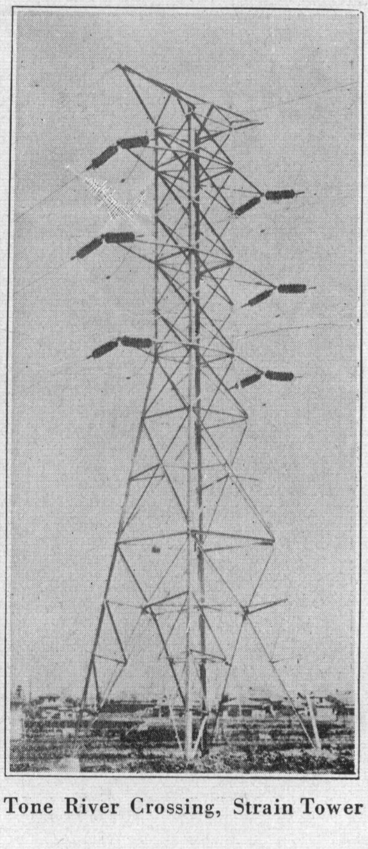
Type "A" Tower

The No. 2 Inawashiro power plant is located about 1,000-ft. down the stream from the site of No. 1 power-house, and is equipped throughout with machinery and apparatus made in Japan. The five penstocks were turned out by the Tokyo Ishikawajima Shipbuilding Company and the five water turbines at the Kobe works of the Mitsubishi Dockyard and Shipbuilding Company. These turbines are of the horizontal twin spiral Francis type with a capacity of 10,250 h.p. at full gate opening. The speed is 375 r.p.m., and the effective head at full gate 226.5-ft. The alternating generators, six in number, are of the totally enclosed forced draught horizontal type of 6,000 k.w. capacity each, with a power factor of 90, three phase, 6,600 volts, 50 cycles, and 375 r.p.m., manufactured by the Shibaura Engineering Works. The exciters, five in number, and the main transformers are also from the Shibaura Engineering Works. The 115,000 volt transmission line into Tokyo, 140 miles in length, is carried on a total of 1,449 steel towers of three sizes made by the American Bridge Company. The receiving station for this No. 1 Inawashiro transmission line, located near the Tabata railway station in Tokyo, is equipped with twelve 4,000 k.v.a. Westinghouse shell type transformers and high tension breakers, and nine 500 k.v.a. auxiliary transformers made by the Shibaura Engineering Works. This station is also equipped with two 7,500 k.v.a. synchronous condensers and exciters, which with their switch gear were also made by the Shibaura Engineering Works. The main switchboard and switching apparatus, as well as the testing transformers, were supplied by the Westinghouse Electric and Manufacturing Company.

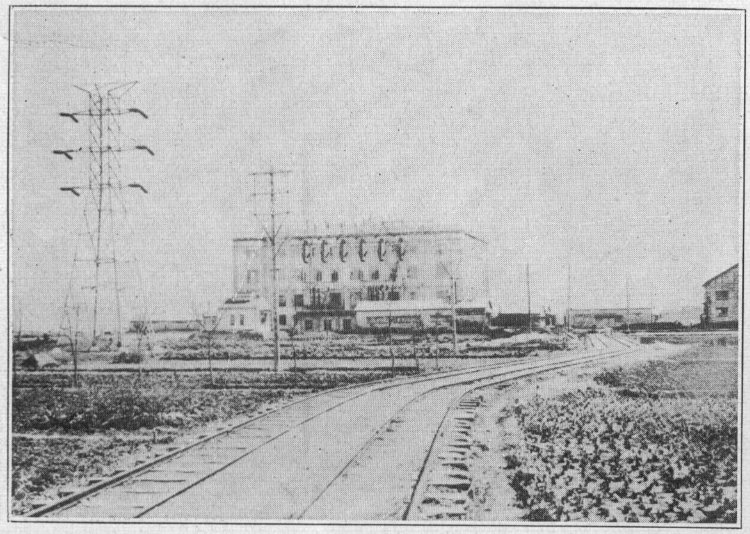
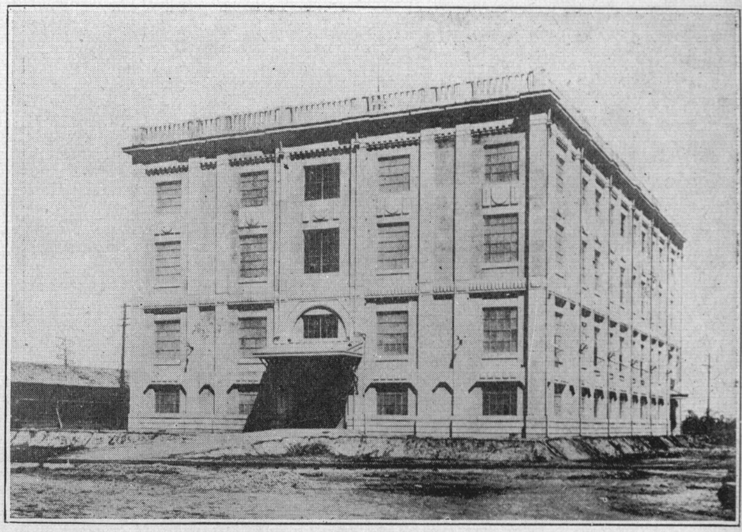
This original Inawashiro power supply soon became taxed to the limit, and by 1921 the number of lights in Tokyo had increased to over 3,000,000, with a total load calling for over 200,000 k.w. To meet this demand the Tokyo Electric Light Company erected its 154,000 volt Joetsu transmission line into the Shinano river district, bringing 50,000 k.w. of power from the two generating stations on the Nakatsu river (operated by the Shin-yetsu Electric Power Company, a subsidiary of the Tokyo company) to the Kameido receiving station in Tokyo.

Of these stations, Nakatsugawa No. 1 is equipped with three General Electric 14,444 k.v.a. horizontal generators driven by Allis Chalmers water turbines. Power is stepped up by a bank of three G.-E. 15,000 k.v.a. water-cooled transformers to the line potential of 154,000 volts. Nakatsugawa No. 2, the older of these stations, has two General Electric 9,500 k.v.a. generators and a bank of three 6,667 k.v.a. G.-E. transformers connected to the main transmission line.

Other power stations are tapped into this line at two points, as shown on the map of the transmission system which accompanies this article. At Kayatsuki, four 7,000 k.v.a. self-cooled transformers step-up the power from the four 4,375 k.v.a. generators at the Yusawa generating station, and further down the line, at Komatsu, four giant transformers of three, winding each 21,000 k.v.a., are installed, the tertiary winding receiving the power at 6,600 volts from the Komatsu station equipped with four 4,800 k.v.a. generators. The primary winding receives power from the 66,000 volt transmission line, which in turn is fed by the Iwamuro and Kamikuya generating stations. The Iwamuro station includes three 6,000 k.v.a. generators



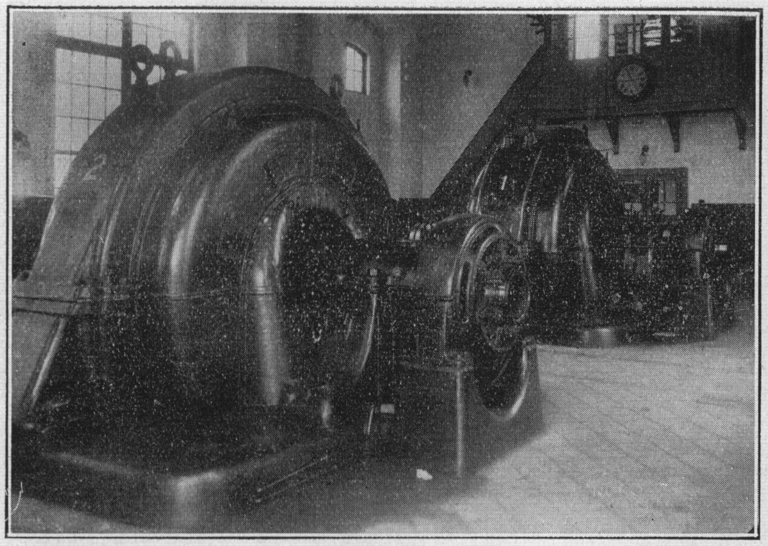
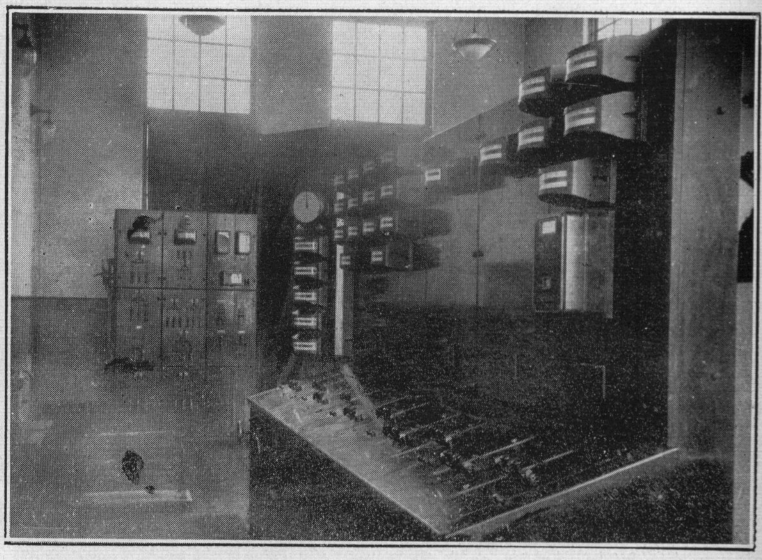
Tone River Crossing, Strain Tower

Tabata Receiving Station, Tokyo. Front and Rear Views.

feeding into two banks, each consisting of three 2,000 k.v.a. OIWC transformers.

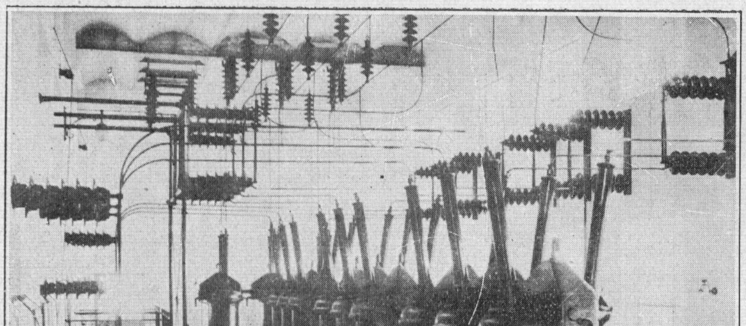
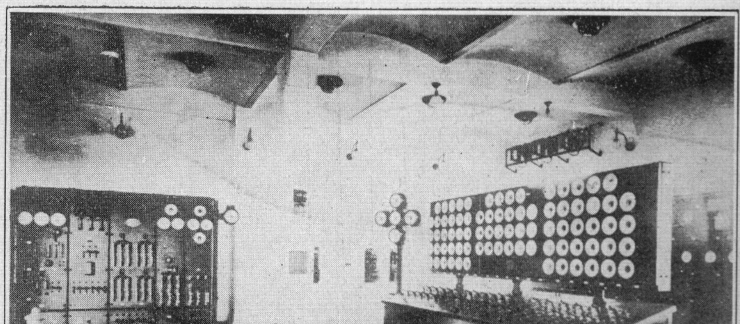
The Kamikuya station consists of three 6,667 k.v.a. generators feeding into a bank of three 6,700 k.v.a. transformers. A spare transformer is provided in each station. The Kameido sub-station at Tokyo, installed in 1922, has nine 15,000 k.v.a. G.-E. transformers with two 15,000 k.v.a. synchronous condensers for regulating the voltage. Westinghouse high tension switchboard equipment designed for heavy duty, including the largest size of "G-22" breakers, are used throughout on the Joetsu transmission line. This line is to be further loaded by the installation of the Kochi power station, which will feed about 16,000 k.w. into the Komatsu

Tabata Receiving Station, Tokyo

Two 7,500 (9,000 maximum) k.v.a. Synchronous Condensers

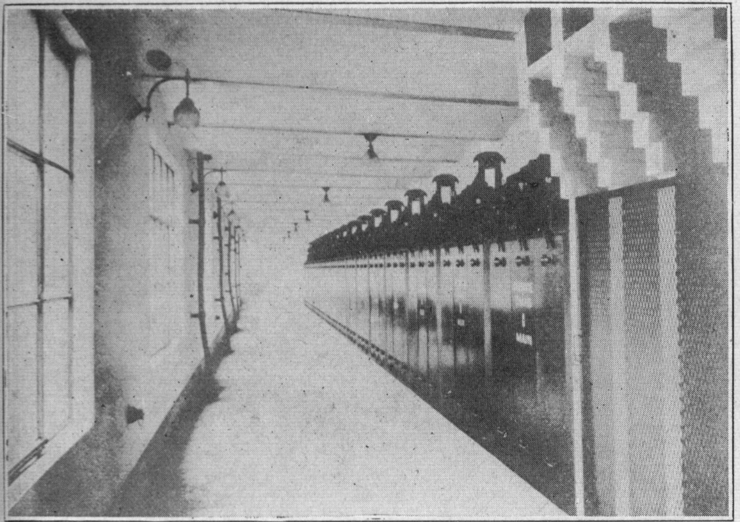
Control Board for the Synchronous Condensers

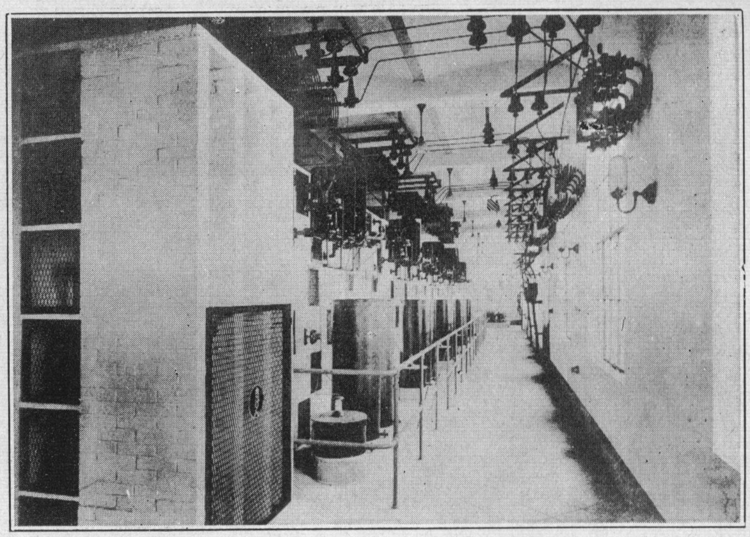



Tabata Receiving Station, Tokyo

High Tension Switch Room

Main Control and Service Board





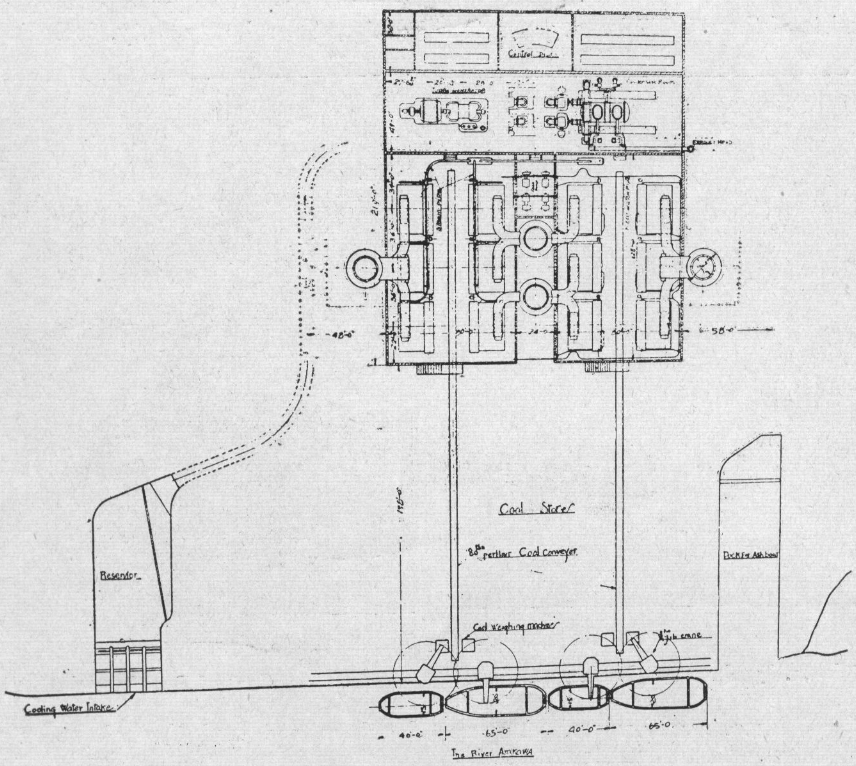
Tabata Recieving Station, Tokyo

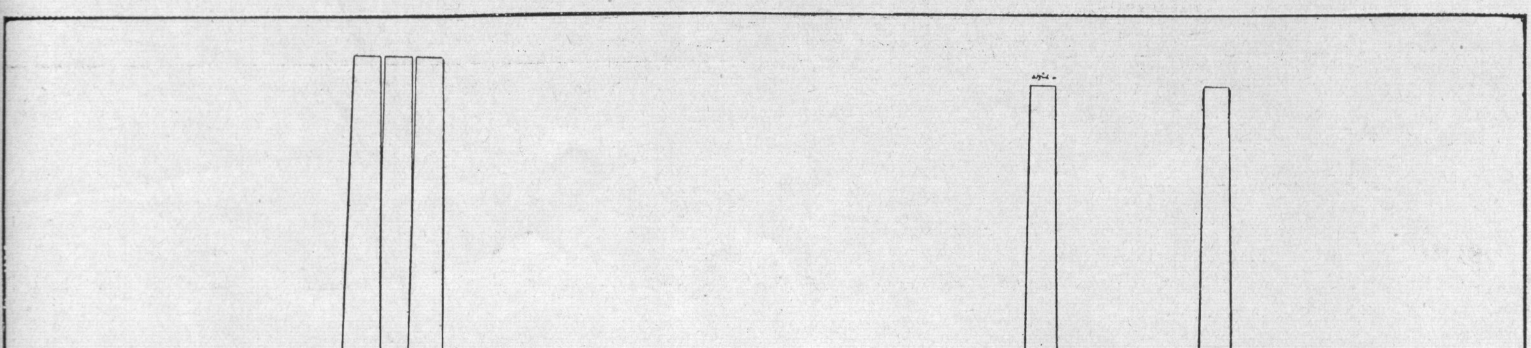
11,005 Volt Oil Switch Room. **11,000 Volt Busbar Room.**

step-up transformers. Furthermore, this line will be called upon to receive the power from the great 150,000 k.w. hydro-electric plant on the Shinano river, to be built by the Shin-yetsu Electric Power Company. When the Joetsu transmission line is increased to carry the full load from the Shinano and Nakatsu river stations, the total power from this one line will amount to over 250,000 k.w.

By September 1923 the demand for power in Tokyo had again almost reached the available generating capacity of the Tokyo Electric Light Company's system. At the end of May 1923 the company was supplying 4,220,000 lights and 272,000 k.w. of power, and plans were at once devised for immediate extension. The earthquake caused a temporary reduction in power and lighting demands, but by the end of 1924 the demand had again reached the limit of generating capacity, and prompt steps were again made to supply the climbing load.

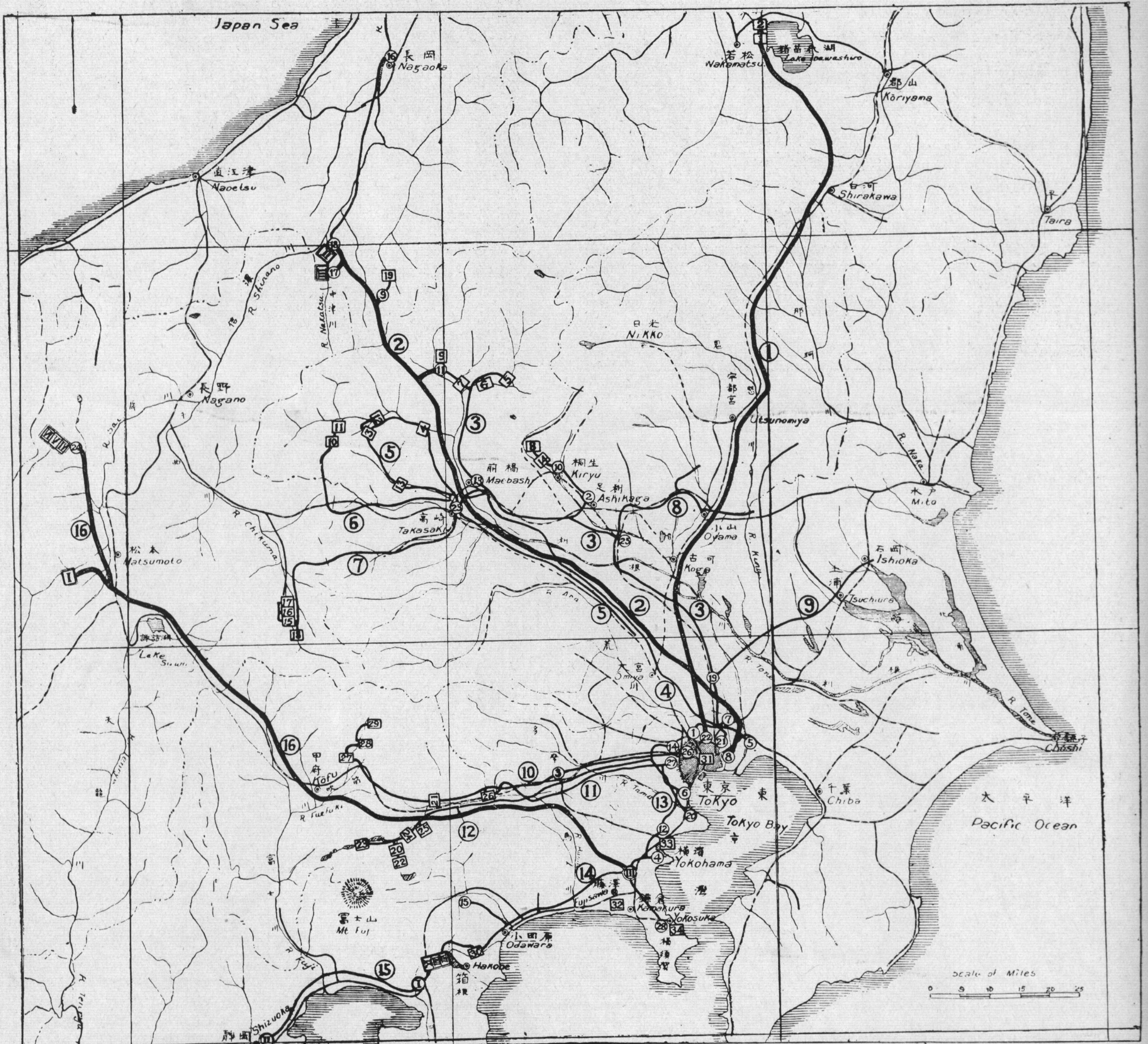
This new extension is the one briefly referred to above, utilizing the additional power stored in Lake Inawashiro for the erection of the No. 3 and No. 4 Inawashiro stations, supplemented by the Senju steam station. It also calls for another Inawashiro transmission line to carry 154,000 volts to Tokyo. Recognizing that even with these two new stations the increased supply would only satisfy the rapidly mounting demand for a short period, provision was made in the transmission equipment to bring additional power from





Plan and Side Elevation of the 50,000 k.w. Senju Steam Power Station of The Tokyo Electric Light Company, Now in Process of Erection.

Transmission System of Tokyo Electric Light Co. Oct. 1923.



□ 東京電燈會社發電所. Generating Station of Tokyo E. L. Co.
□ 傍系會社發電所. Generating Station of Subsidiary Co.
○ 東京電燈會社主要變電所. Main Substation of Tokyo E. L. Co.
○ 傍系會社變電所. Substation of Subsidiary Co.
十万「ヴォルト」以上送電線路. Transmission Line above 100,000 volts.
十万「ヴォルト」以下送電線路. Transmission Line below 100,000 volts.
○ 送電線路系統. System of Transmission Line.

發電所及變電所. Generating Station & Substation

東京電燈會社 Tokyo E. L. Co.

水力發電所 Water Power Plant.

1. 猪苗代第一 Inawashiro No. 1.	2. 猪苗代第二 Inawashiro No. 2.	3. 厚田 Atsuta.	4. 箱島 Hakoshima.	5. 岩室 Iwamuro.
6. 上久屋第一 Kamikuya No. 1.	7. 上久屋第二 Kamikuya No. 2.	8. 貴船 Kifune.	9. 小松 Komatsu.	10. 熊川第一 Kumakawa No. 1.
11. 熊川第二 Kumakawa No. 2.	12. 温川 Nurukawa.	13. 里見 Satomi.	14. 高津戸 Takatsudo.	15. 土村第一 Domura No. 1.
16. 土村第二 Domura No. 2.	17. 土村第三 Domura No. 3.	18. 箕輪 Minowa.	19. 湯澤 Yuzawa.	20. 鐘ヶ淵 Kanegafuchi
21. 駒橋 Komahashi.	22. 忍野 Oshino.	23. 西湖 Saiko.	24. 鹿留 Shishidome.	25. 谷村 Yamura.
26 八ッ澤 Yatsuzawa	27. 笛吹川第一 Fuefukigawa No. 1.	28. 笛吹川第二 Fuefukigawa No. 2	29. 笛吹川第三 Fuefukigawa No. 3.	30. 塔ノ澤 Tō no sawa

火力發電所 Steam Power Plant

31. 淺草 Asakusa.	32. 江ノ島 Enoshima	33. 神奈川 Kanagawa.	34. 若松町 Wakamatsuchō.

主要變電所 Main Substation.

1. 荒川 Arakawa	2. 足利 Ashikaga.	3. 八王子 Hachiōji.	4. 程土谷 Hodogaya.	5. 市川 Ichikawa.
6. 池上 Ikegami	7. 龜有 Kameari	8. 龜戸 Kameido.	9. 萱村 Kayatsuki,	10. 桐生 Kiryū.
11. 小松 Komatsu	12. 子安 Koyasu.	13. 前橋 Maebashi.	14. 目白 Mejiro.	15. 峰 Mine.
16. 長岡 Nagaoka.	17. 中津川第一 Nakatsugawa No. 1.	18. 中津川第二 Nakatsugawa No. 2.	19. 大相模 Ōsagami.	20. 六郷 Rokugo
21. 隅田 Sumida	22. 田端 Tabata.	23. 高崎 Takasaki.	24. 高瀬川 Takasegawa.	25. 館林 Tatebayashi.
26. 早稲田 Waseda.	27. 淀橋 Yodobashi.	28. 横須賀 Yokosuka.		

傍系會社 Subsidiary Co.

水力發電所 Water Power Plant.

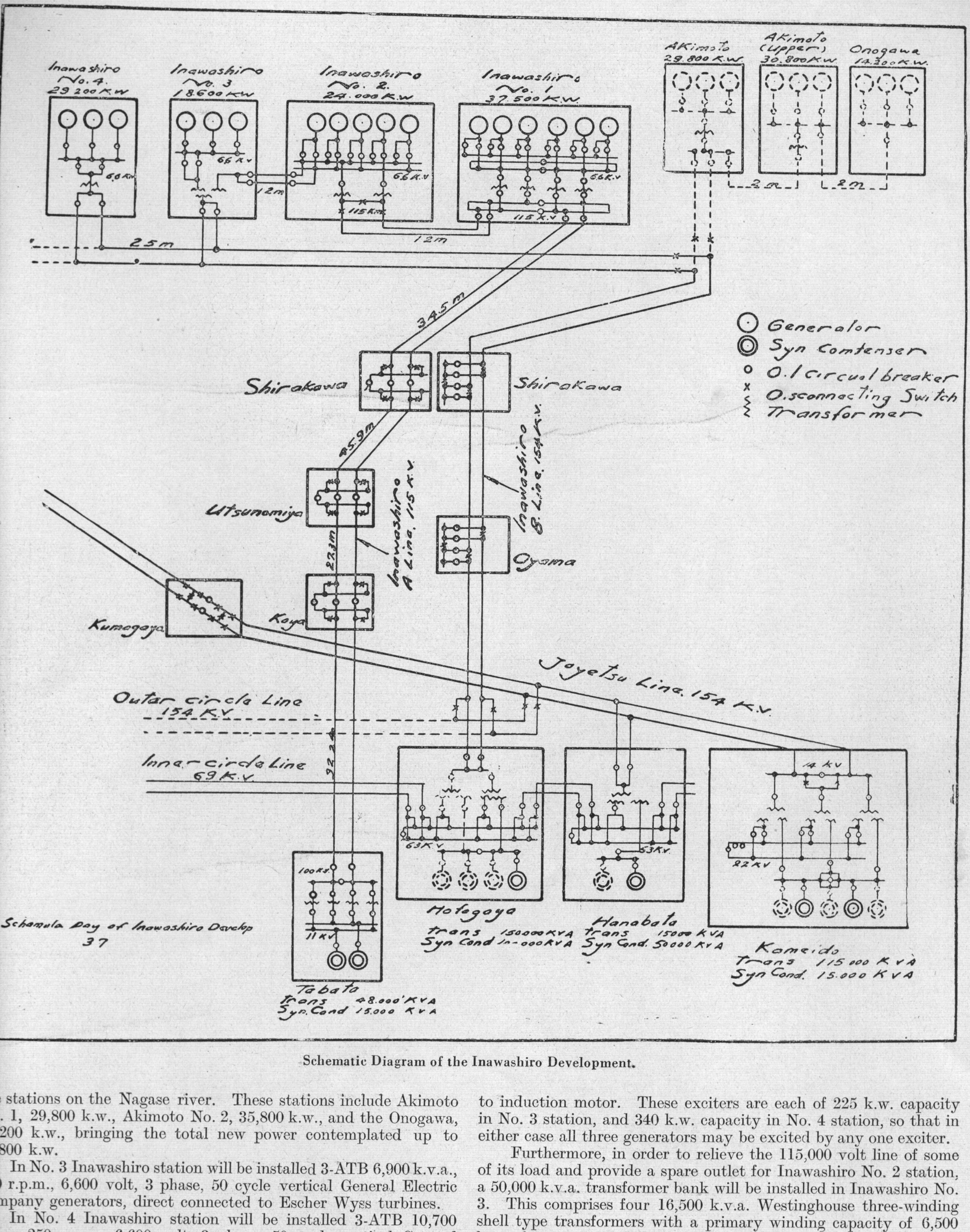
I. 龍島 Ryūshima.	II. 中津川第二 Nakatsugawa No. 2.	III. 中津川第一 Nakatsugawa No. 1.	IV. 高瀬川第一 Takasegawa No. 1.	V. 高瀬川第二 Takasegawa No. 2.
VI. 高瀬川第三 Takasegawa No. 3.	VII. 深良川第一 Fukaragawa No. 1.	VIII. 深良川第二 Fukaragawa No. 2.	IX. 深良川第三 Fukaragawa No. 3.	

變電所 Substation.

I. 三島 Mishima.	II. 靜岡 Shizuoka.	III. 戸塚 Tozuka.

送電線路系統. System of Transmission Line.

1. 猪苗代 Inawashiro.	2. 上越 Jōetsu.	3. 前橋(舊) Maebashi. (Old)	4. 前橋(新) Maebashi. (New)	5. 高崎 Takasaki.
6. 熊川 Kumakawa.	7. 東信 Tōshin.	8. 栃木 Tochigi.	9. 茨城 Ibaragi.	10. 駒橋 Komahashi.
11. 八ッ澤 Yatsuzawa.	12. 谷村 Yamura.	13. 子安 Koyasu.	14. 箱根 Hakone.	15. 靜岡 Shizuoka.
16. [illegible]				



Schematic Diagram of the Inawashiro Development.

the stations on the Nagase river. These stations include Akimoto No. 1, 29,800 k.w., Akimoto No. 2, 35,800 k.w., and the Onogawa, 14,200 k.w., bringing the total new power contemplated up to 79,800 k.w.

In No. 3 Inawashiro station will be installed 3-ATB 6,900 k.v.a., 250 r.p.m., 6,600 volt, 3 phase, 50 cycle vertical General Electric Company generators, direct connected to Escher Wyss turbines.

In No. 4 Inawashiro station will be installed 3-ATB 10,700 k.v.a., 250 r.p.m., 6,600 volt, 3 phase, 50 cycle vertical General Electric Company generators, direct connected to Escher Wyss turbines.

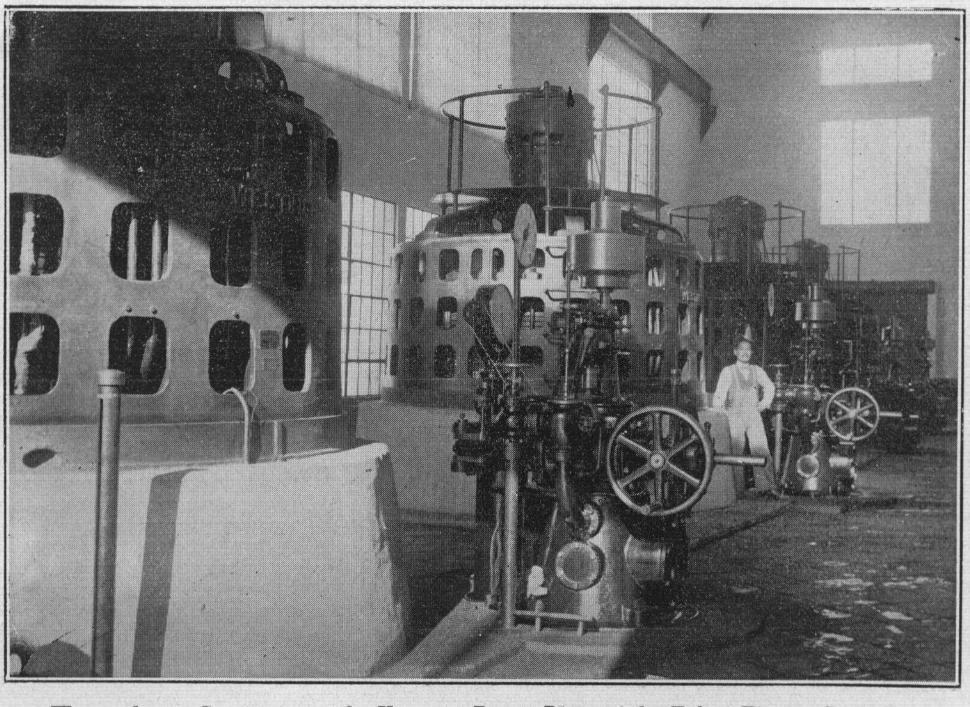
In each station excitation of 250 volts D.C. will be supplied by two exciters, one water wheel driven, the other connected direct to induction motor. These exciters are each of 225 k.w. capacity in No. 3 station, and 340 k.w. capacity in No. 4 station, so that in either case all three generators may be excited by any one exciter.

Furthermore, in order to relieve the 115,000 volt line of some of its load and provide a spare outlet for Inawashiro No. 2 station, a 50,000 k.v.a. transformer bank will be installed in Inawashiro No. 3. This comprises four 16,500 k.v.a. Westinghouse three-winding shell type transformers with a primary winding capacity of 6,500 k.v.a. for stepping up the 6,600 volt power from Inawashiro No. 3.

The tertiary winding is designed for 6,370 volts, with tap for 6,900 volts, and a secondary wound for 154,000 volts, with tap approximately 5 and 7½ per cent. above normal. When power is received from Inawashiro No. 2, the line drop will feed into the

6,370 volt taps, while should a fault occur on the 154,000 volt transmission line it will be possible to feed the power back through the No. 2 generating station, and thence through transformers to the 115,000 volt line by connecting on the 6,900 volt tap.

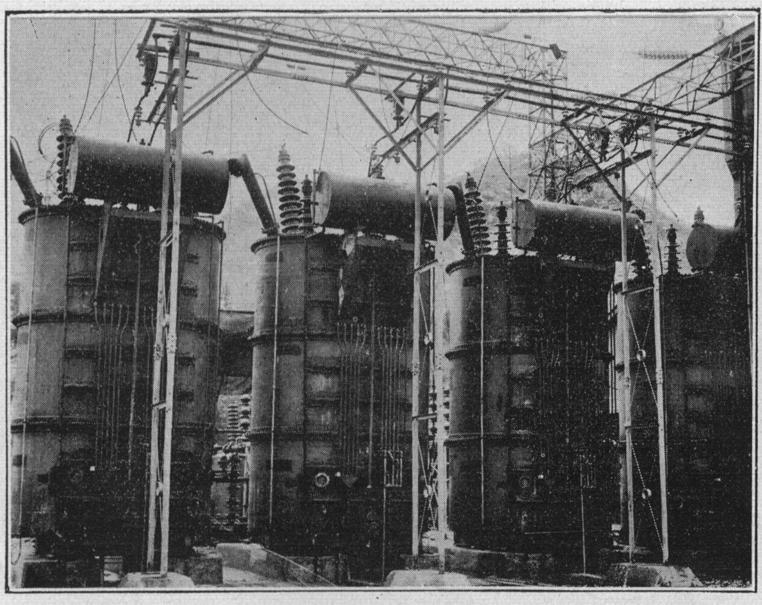
The transformers at Inawashiro No. 4 station are supplied by the General Electric Company and consist of 4-WCJ 50 cycle, 10,000 k.v.a., 89,000/-154,000 Y-6,600 volt units. On the way to Tokyo two switching stations, the Shirokawa and the Oyama, are provided for on the 154,000 volt line, and the double circuit transmission line on arriving at Tokyo is divided between two sub-stations, one at Hanabata and the other at Hatogaya.



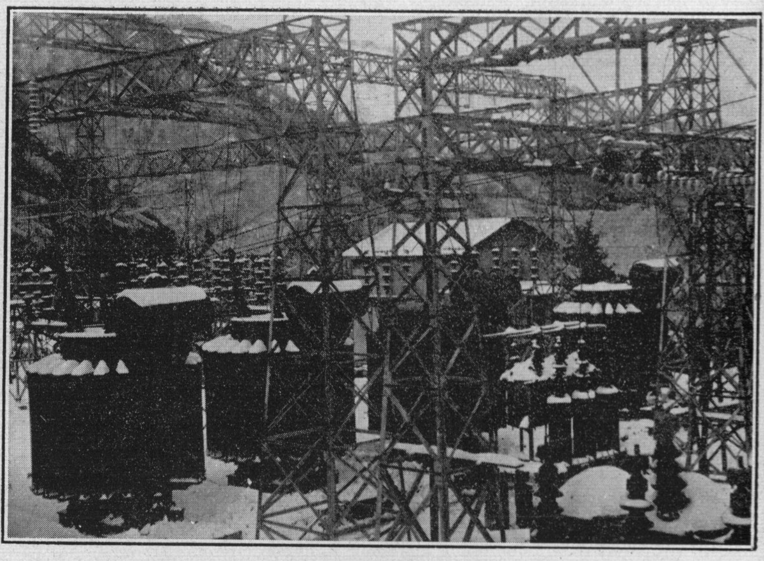
Westinghouse Generators at the Komatsu Power Plant of the Tokyo Electric Light Co.

The Hanabata sub-station will be provided with three 25,000 k.v.a. three-winding transformers, receiving power at 140,000 volts. The secondary winding will deliver approximately 28,000 k.v.a. per transformer to the 66,000 volt distributing belt line which will surround Tokyo.

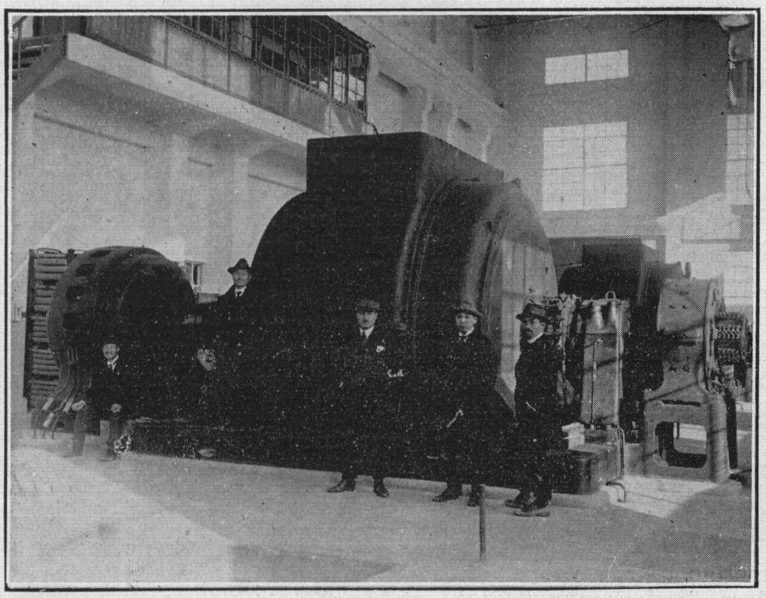
The tertiary winding at 11,000 volts will supply current to two 25,000 k.v.a. synchronous condensers and some local feeders. These synchronous condensers; furnished by the General Electric Company are rated ATI. 10 pole, 25,000 k.v.a., 600 r.p.m., 11,000 volt, 3 phase, 50 cycle.,

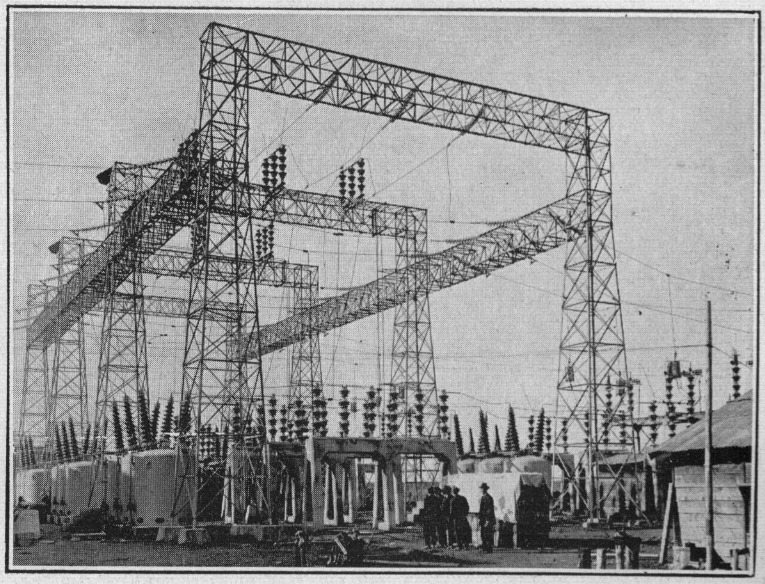


Outdoor Switching Equipment of the Komatsu Sub-station of the Tokyo Electric Light Co.; Westinghouse Type "G-2" O.C.B.



Keyatsuki Sub-station of the Tokyo Electric Light Co., Westinghouse Equipment.





Kameido Sub-station

15,000 k.v.a. Westinghouse Synchronous Condensers.

Westinghouse 154,000 volt, 22,000/11,000 Circuit Breakers,

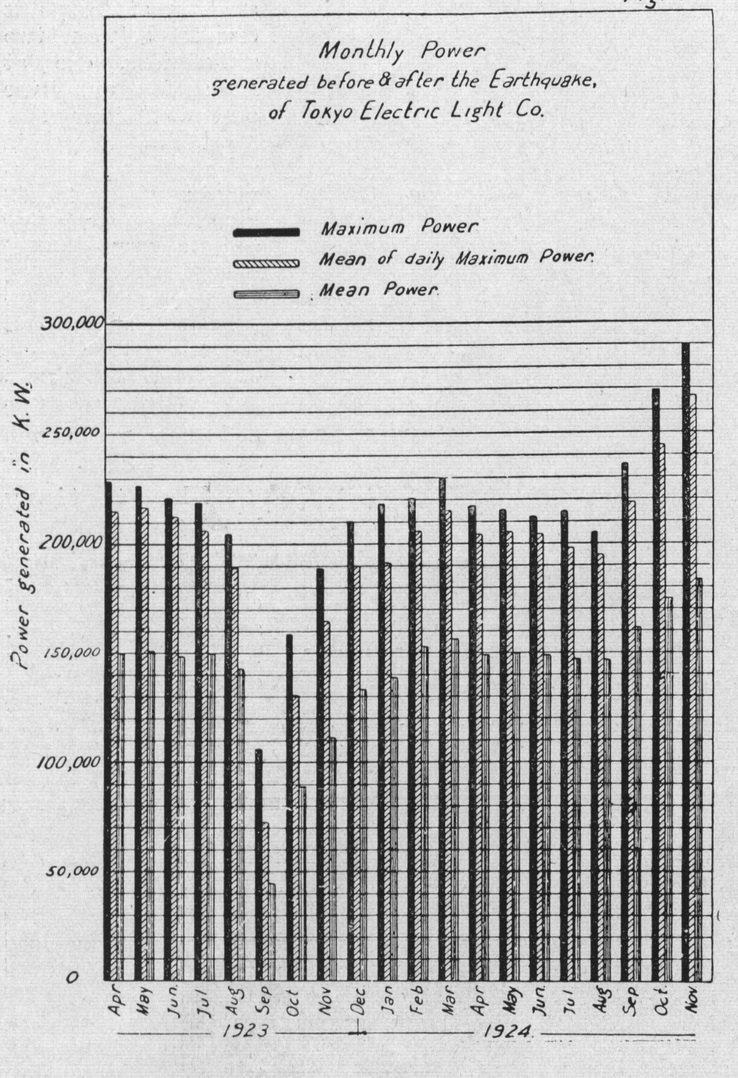


Fig. 1.

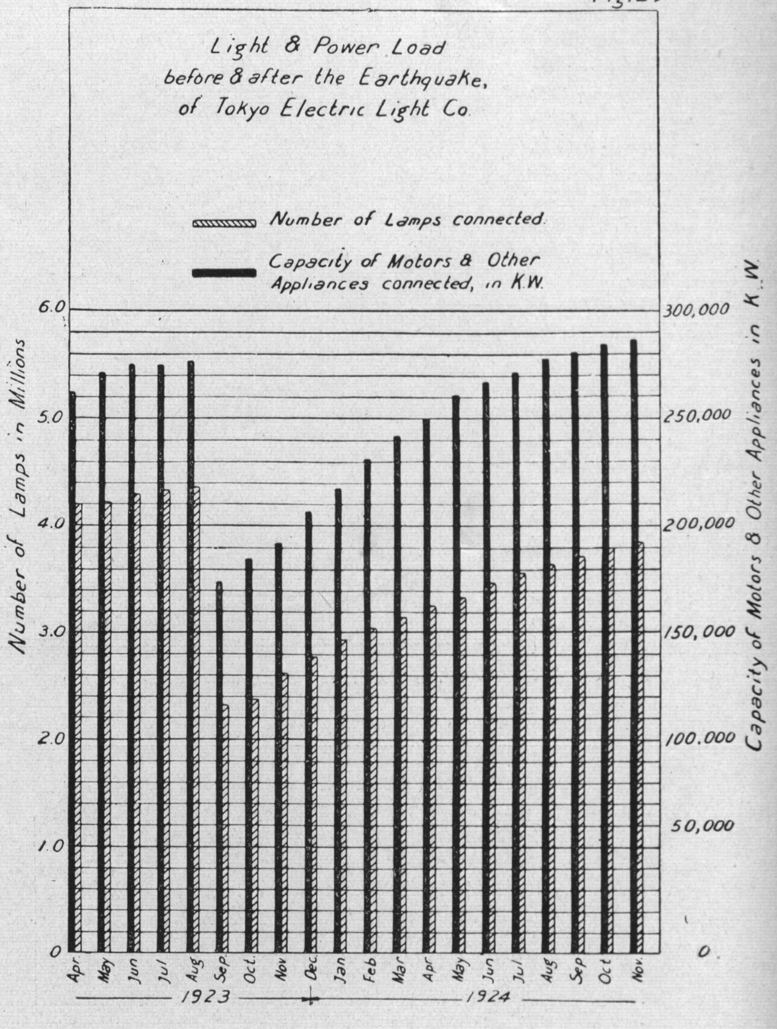


Fig. 2.

The Hatogaya will be practically a duplicate of Hanabata except that provision will be made for doubling the capacity at a future date. It will then contain 150,000 k.v.a. of transformers, and a 100,000 k.v.a. of synchronous condensers. The Hatogaya is directly connected to a double circuit transmission line, and provision is made for connecting it to the Joyetsu line. The Hanabata station will for the present supplement the Kameido station in handling power from the Joyetsu line. The diagram on page 378 fully describes the contemplated arrangement of the Inawashiro development and the location of their transmission and belt lines.

The other great 154,000 volt transmission line feeding into the Tokyo district is the Keihin, carrying power from the Ryushima and the three Takesegawa stations in the Fuji district to the Totsuka sub-station near Yokohama. However, the recent power demands in Tokyo have resulted in a connection with the Keihin high tension line at Shiojiri through seven 10,000 k.v.a. Westinghouse transformers to tap the great Daido system. This Daido power comes from its Momoyama generating station, taking 17,000 k.w. from this source. Another 34,000 k.w. is taken from the Takesagawa station of the Toshin Electric Company and 25,000 k.w. of this combined power is diverted to Tokyo through the Hashimoto switching station, where it is stepped down by a 50,000 k.v.a. Westinghouse transformer back to 66,000 volts and conveyed to the Senzoku sub-station near Tokyo. Thus, through the interlocking systems of the Tokyo Electric, Keihin and the Daido, a tie is effected between Tokyo and Osaka which will in future years feed power back and forth according to the relative demands of these two great centres of industry and population.

The Shinano and Nagatsu Power District

The Tokyo Electric Light Company's Joetsu 154,000 volt transmission line taps the Shinano and Nagatsu river power district, one of the most important of Central Japan. Here, on the Nagatsugawa, are located the two completed power-houses of the Shinyetsu Electric Power Company (a subsidiary of the Tokyo Electric Light Company), feeding 57,000 k.w. into the Joesutsu line, with a further 14,000 k.w. projected installation utilizing the same water-power. On the Shinano river, further down stream, the same company proposes to erect a 160,000 k.w. station, and still further down is to be located the super-power plant of the Imperial Railways for furnishing the current to operate the main Tokaido railway line. A map of this district is shown on page 408.

The current generated at the No. 2 power-house is boosted from 11,000 volts up to 66,000 at the open-air transformer station of the Tokyo Electric Light Company, and together with the current from the power-houses at Yuzawa, Komatsu, Iwamuro and others, is transmitted to the Kameido transformer station at Tokyo, a distance of 127 miles. The capacity of the plant is 18,000 k.w.

The effective head of water is about 560 *shaku* (559-ft.), with a flow of 500 cubic *shaku* per second. There are two Allis-Chalmers Francis water wheels of 13,000 h.p., each working at 600 r.p.m. direct, connected to two General Electric generators of 10,000 k.v.a. each, 11,000 volts, 50 cycles. The switchboard instruments and appliances are from the Westinghouse Electric Manufacturing Company. There are four open-air transformer stations (one in reserve), each of 6,700 k.v.a. capacity, single phase, where the first pressure of 11,000 volts is stepped up to 89,000 volts (with 66,000 taps). With star connections this pressure is still further boosted to 154,000 volts.

The water supply for this power-house passes through a tunnel two *ri* in length, fed from a regulating resrvoir with an effective depth of 8-ft. and a capacity of 2,430,000 cubic *shaku*. The normal flow is 350 cu. *shaku* per second, and with the maximun flow of 500 cu. *shaku* per second the reservoir will supply the plant for a continuous run at its full capacity of 18,000 k.w. for 4½ hours. A special feature of this plant is a rolling head gate.

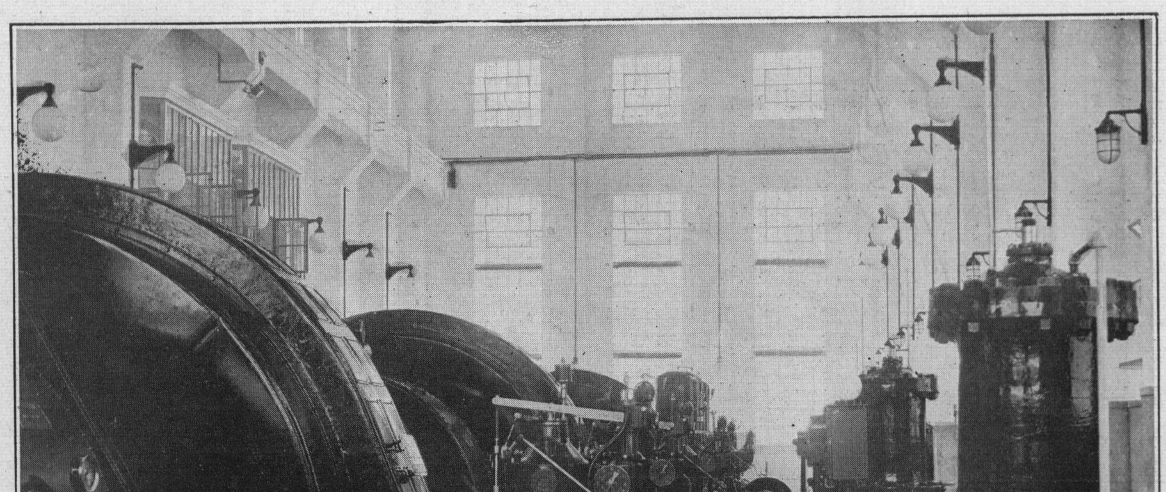
No. 1 Power House

This is a new power house just completed, located at a point 120 yards below the intake to the No. 2 plant in order that its used water may raise the volume of the river water which flows lthrough the head race of the No. 2 plant.

The control dam in the main river at the intake is 100-ft. ong, with an additional dam 50-ft. long across the branch stream which flows into it at this point. The head gate is of the rolling type, 40 feet in length by 5-ft. in diameter. The head race is 20,900 yards long with a gradient of 1-1,250. Almost all of this is tunnel work which covers 19,649 yards, the rest being covered ditch. The regulating tank has an effective capacity of 2,500,000 cubic *shaku* with an effective depth of 8.7-ft.

The flume pipes are three in number, arched and lap riveted. The total length is 2,697 feet, with a diameter at the top of 5 feet and a thickness of $\frac{3}{8}$ inch, increasing to $1\frac{13}{16}$ inches at the lowest part where the diameter of the pipe reduces to $3\frac{1}{2}$-ft. These come together in a Y, the ends of which taper off to the sluice gate valves. The total weight of these pipes is 2,200 tons. They were supplied by the Kellogg Company of America.

The power-house building has a total area of 1,124 square yards, with 748 square yards devoted to the turbine and generating room. There are also three smaller houses, 3 by 94 *tsubo*. The generating room is equipped with an Hidachi overhead traveling crane 38-ft. long with a lifting capacity of 55 tons. There are three motors, 80, 30 and 10 h.p. respectively, with a speed of 8-ft. in winding, 75-ft. in longitudinal, and 35-ft. latitudinal movement per minute.



Generating Room of the No. 1 Nakatsugawa Power House of the Shin-yetsu Hydro Electric Company, Equipped with Three 14,444 k.v.a. General Electric Generators driven by Three Allis-Chalmers, 18,000 h.p. Impulse Water Wheels; Westinghouse Switchboard

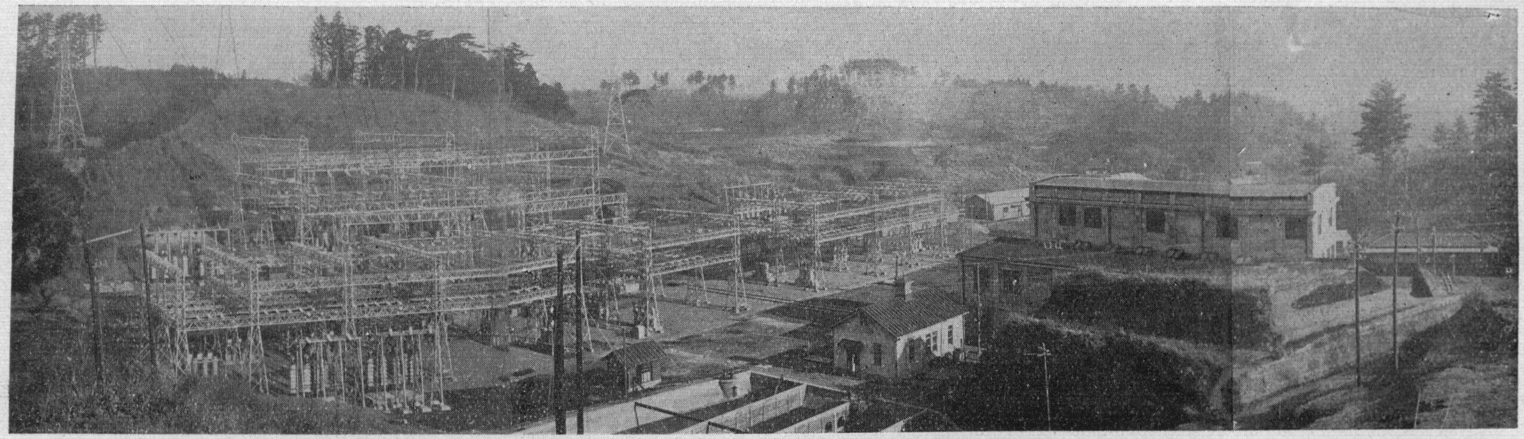
The generating equipment consists of three Allis-Chalmers horizontal axis impulse water wheels with overhung single jets and independent control developing 18,000 h.p. at 3,000 r.p.m. with a specific speed of 3.43. These are connected direct to three General Electric generators, rated at 14,444 k.v.a. three-phase, 50 cycles, 11,000 volts, with a rated efficiency of 97.2 at full load, 96.6 at three-quarter load, and 95.6 at half load. A Westinghouse power regulator of the broad range type is also installed. The 235 k.w. 250 volt General Electric exciter is driven by a 400 h.p. impulse wheel at 985 r.p.m. manufactured by the Dengyosha Company.

The auxiliary equipment of the power-house consists of three station transformers, of which two are three-phase 100 k.v.a., 11,000 volts—220 and 110 volts, and one three-phase 350 k.v.a. transformer 11,000—3,300 volts. There are two 5 k.w., 220 volt generators operated by electric motors for charging the accumulator, which has a capacity of 100 amp. hours, 220 volts, discharging in three hours ; two 15 h.p. motors for the oil pump attached to the speed regulator ; one 3 h.p. motor for the air compressor attached to the oil tank of the speed regulators ; two 25 h.p. motor-driven cooling water pumps. One set of the above equipment is for reserve purposes. The open-air transformer is furnished by the Tokyo Electric Light Company and is provided with four (one in reserve) single-phase oil transformers, 15,000 k.v.a., manufactured by the General Electric Company. The first pressure of 11,000 volts is stepped up to 89,000 volts, and with star connections it produces 154,000 volts. The cooling water comes from the reservoir supplied by the motor-driven cooling pumps.

The difficulties surrounding the construction of the No. 1 power house were trying in the extreme, especially in the transport of materials from the power-house site to the head tank. Up this incline a winding track had to be built with the cars hauled up by winches operated by motors. One of these motors of 550 h.p. operated a winch which raised a load of 50 tons, and another of 300 h.p. operated another winch raising 25 tons. Several special motors were also used to raise loads of ten tons in laying the iron pipes in the head flume. In addition a tramway line 13 miles long (2ft. 6-in. gauge) was laid from the entrance of the gorge to the power-house site on which 24 electric locomotives were in constant operation.

One of the features of this construction job was the two huge stone-crushing plants operated by electricity and equipped with 200-h.p. crushers which had to be erected to supply the work. As the river bottom could not furnish the large amounts of gravel and sand required for concrete mixing, a side of the mountain was blasted out to provide material that was crushed to dust and the screenings used as a substitute for sand and gravel. Over 8,000-lbs. of blasting powder were used in two blasts, and over Y.500,000 expended on the crushing plants alone.

The highest head of water in Japan (1,980 *shaku*; effective, 1,850 *shaku*) is used at the power plant of the Besshi copper mine (owned by the Sumitomo Company), but the capacity of the power plant is only 4,000 k.w. Compared with this, the head of water at the No. 1 power-house of the Shin-yetsu Company, generating more than 200,000 k.w., is the most powerful in Japan. The difficulties in laying the pressure pipe under these conditions were unparalled in Japan. At one place it was necessary to lay the pipe at an angle of 50 degrees. Interest in this plant has not ceased with its completion, as there still remain difficulties that must be met and solved in order to assure its safety and operation during the winter months. Then all the drainage channels in the catchment basin will be blocked with snow, and a continued snowfall may start an avalanche that might block the head entrance. Again the districts over which the transmission line passes are covered deep with snow during the winter months, and the transmission of a 150,000 volt current through this snow-covered territory will be watched with the greatest interest, as it is the first time it has been attempted in Japan.



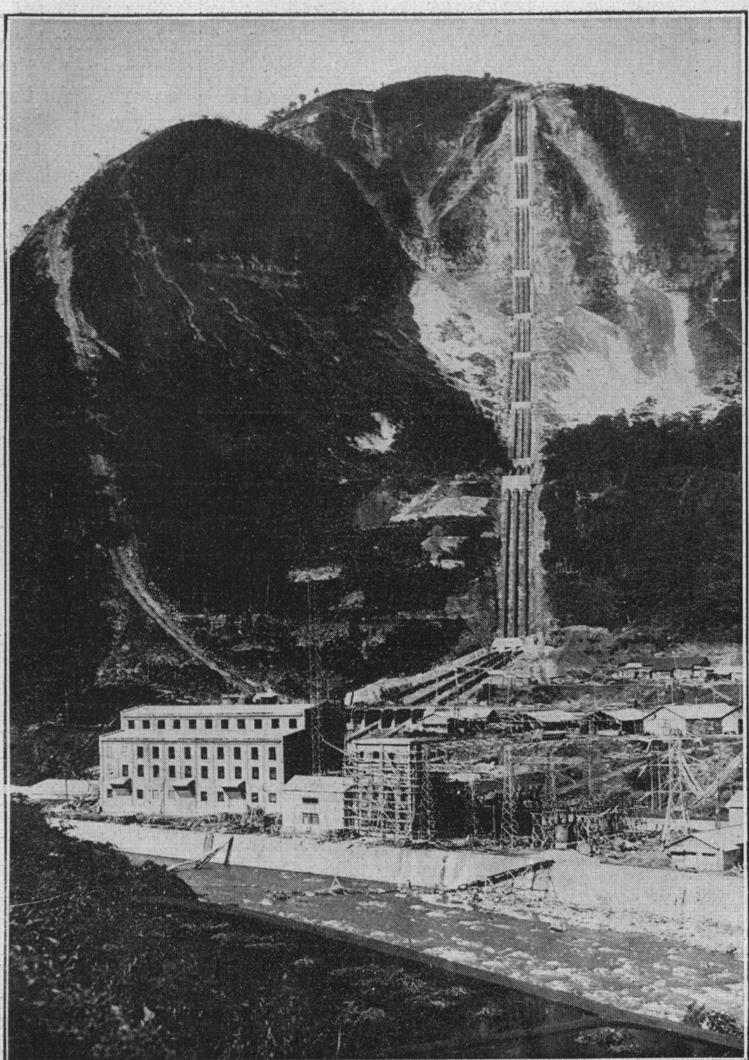
The Yokohama Receiving Station of the Keihin Electric Power Company at Totsuka

The Keihin Line

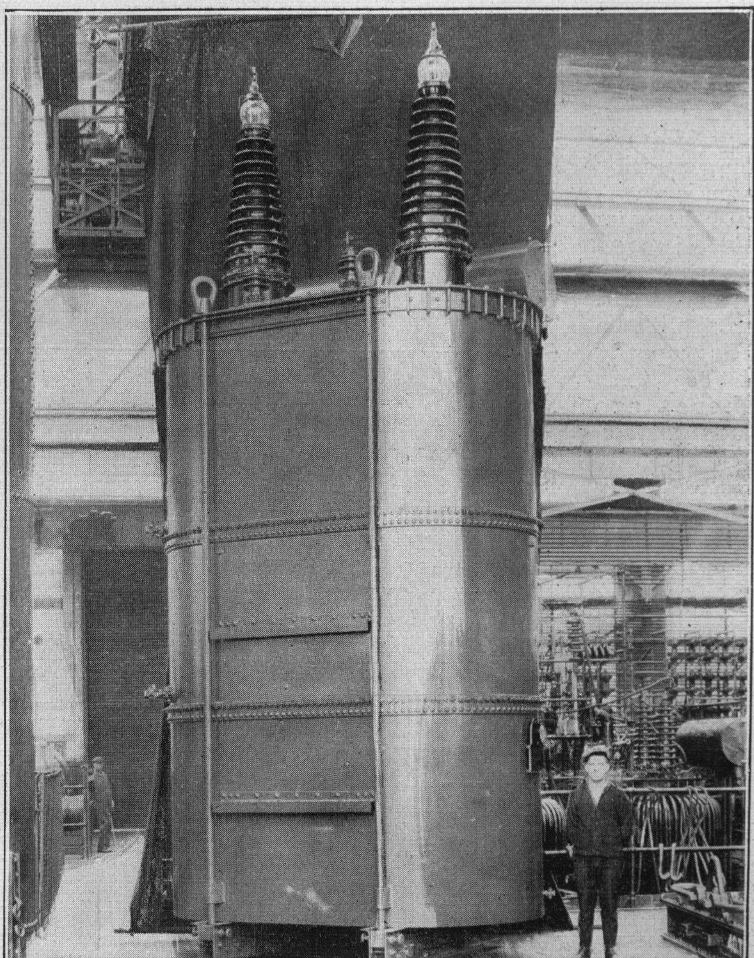
To the south and west of Tokyo lies the Fuji power district, with its lakes and rivers fed from the snows of the surrounding mountains. Here are located some of the largest of the new power stations, feeding on one side into Nagoya and Osaka over the lines of the Daido Electric Power Company, and into Tokyo over the 154,000 volt transmission line of the Keihin Hydro-Electric Company, another subsidiary of the Tokyo Electric Light Company. Over this line is transmitted the initial 17,000 k.w. from the Momoyama plant of the Daido Company, the connecting link between the two great power systems supplying Osaka and the Tokyo district.

The Keihin Hydro-Electric Company was one of the pioneer companies to accept the 154,000 volt transmission standard, feeding at this pressure into Yokohama and Yokosuka since 1923. The first unit of this system is the new Ryushima generating station located on the Saikawa, having a capacity of 20,050 k.w. The receiving station at Yokohama is equipped for 66,000 k.v.a. and the two are connected by 125 miles of double circuit transmission line.

The power for this station is obtained from the Saikawa river, which has its source on the Japanese alps. The normal flow is 720 cubic feet per second and 400 cubic feet minimum, with an effective head of 430-ft. The water, led through a canal 5.78 miles long (97 per cent. tunnels), takes in the Oshirokawa and Kurokawa rivers on its way to the head tank at Ryushima. Two lines of riveted steel pipe, 810-ft. long, 7-ft. 6-in. and 7-ft. in diameter, $\frac{5}{16}$-in. and $\frac{5}{16}$-in. minimum and maximum thickness, convey the water from the head tank to the station. There are also two regulating ponds with storage capacities of 1,920,000 and 2,260,000 cubic feet for assuring the peak load during the winter months.



No. 1 Power House of the Shin-yetsu Electric Power Company located on the Nakatsu River 43,333 k.v.a.

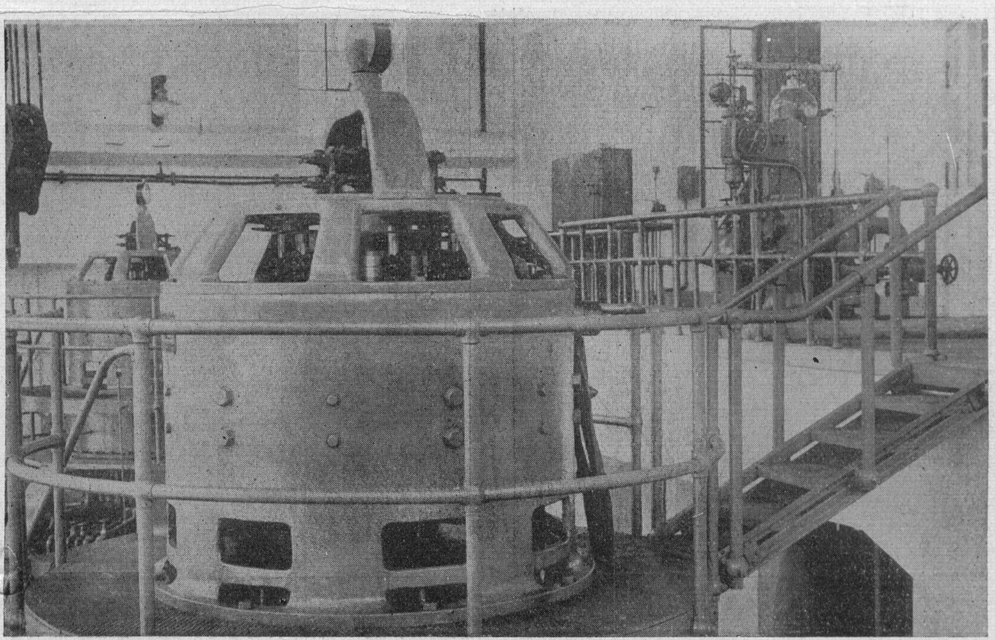


Type WCJ-50-10,000-89,000/154,000 Y-6,600 General Electric Outdoor Transformer for the 154,000 volt Joyetsu Transmission Line of the Tokyo Electric Light Company, Ltd,

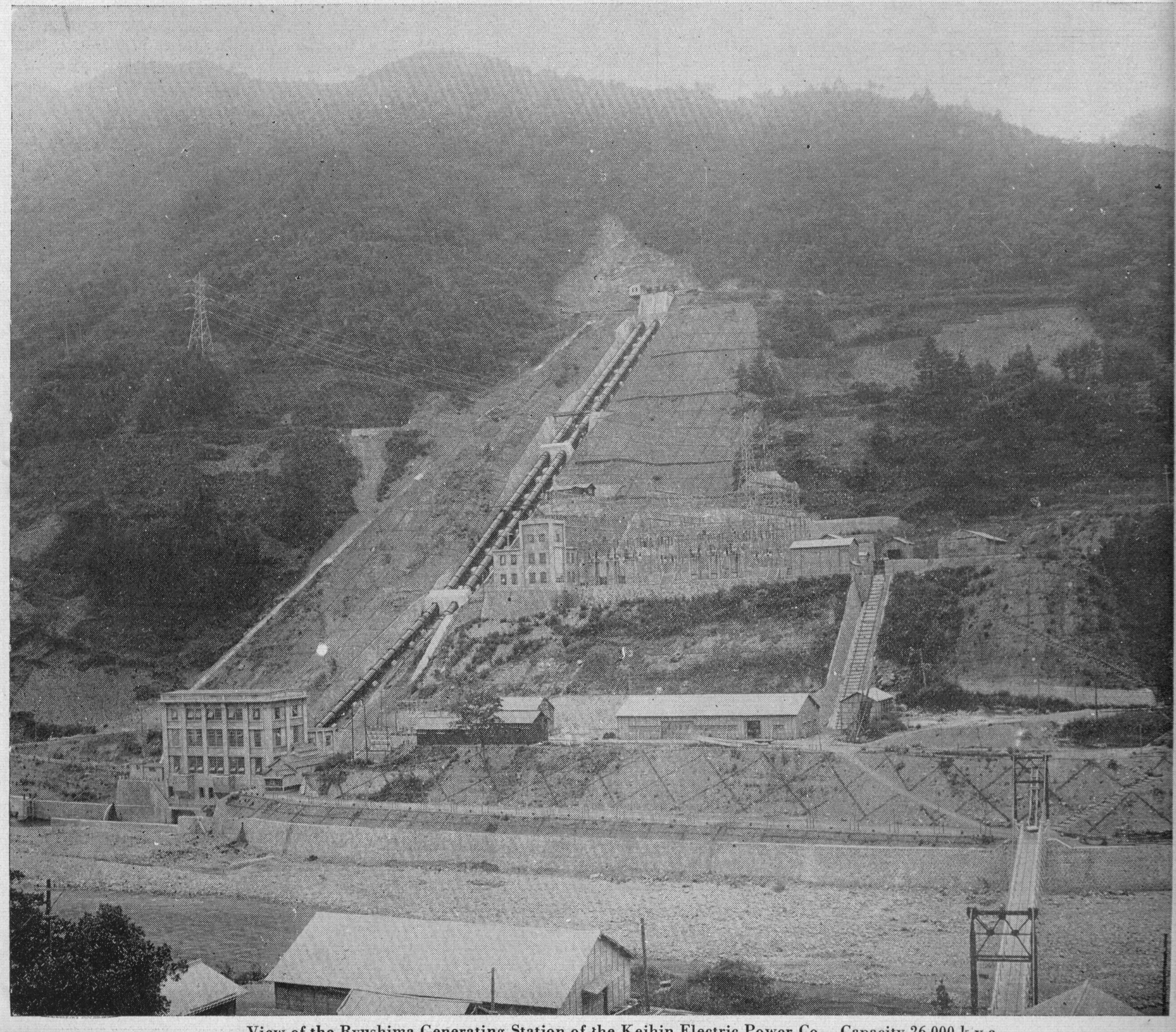
Power House

As will be seen from the illustration, the power station consists of an indoor and outdoor installation, the latter being located half way up the hill. The power-house of reinforced concrete construction is equipped with two Allis-Chalmers vertical shaft Francis type turbines developing a maximum of 18,000 horse-power at 375 r.p.m. These turbines are provided with water cooled lignum-vitae bearings and telescopic draft tubes for easy handling and inspection of the runners. The governors, installed on the switchboard floor for convenience of attendance, are fitted with shaft fly-balls. Pressure regulators of 60 per cent. discharge capacity are also provided for safety.

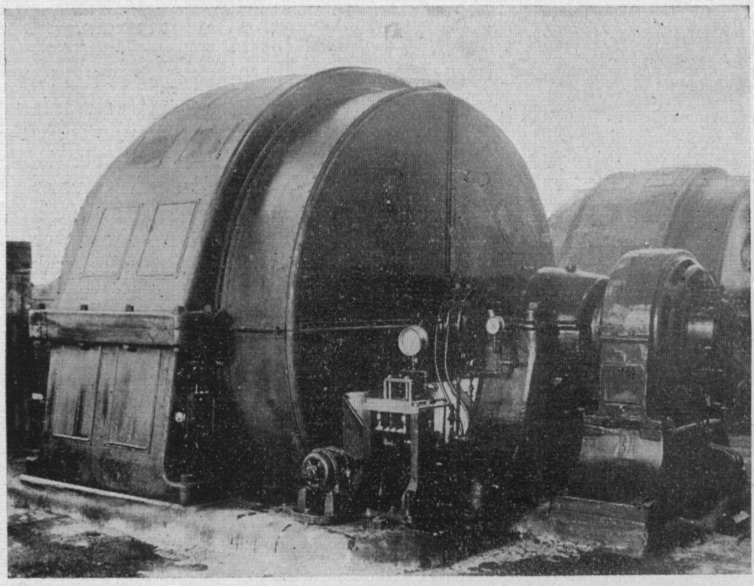
The turbines are coupled direct to General Electric generators, each 13,000 k.v.a., 6,600 volts, 50 cycles, with fly-wheel effect of 1,100,000-ft.-lbs. These generators are fitted with spring thrust bearings. The direct coupled exciters are 180 k.w., 250 volts, direct current, shunt type

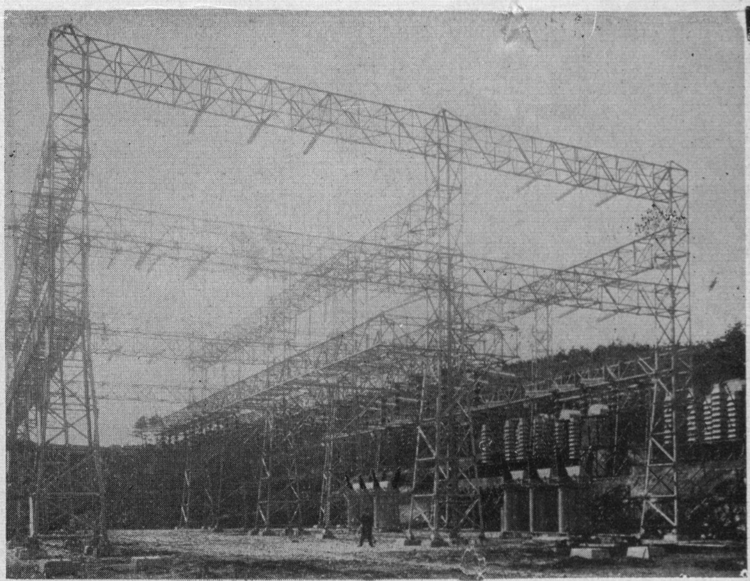


Direct Coupled Exciters at the Ryushima Station, showing also the Allis-Chalmer Turbine Governor in Switchboard Floor



View of the Ryushima Generating Station of the Keihin Electric Power Co. Capacity 26,000 k.v.a.





YOKOHAMA RECEIVING STATION, KEIHIN ELECTRIC POWER COMPANY

15,000 k.v.a. Synchronous Condensers

Outdoor Sub-Station, 154,000 volt side

with commutating poles, each capable of exciting two generators.

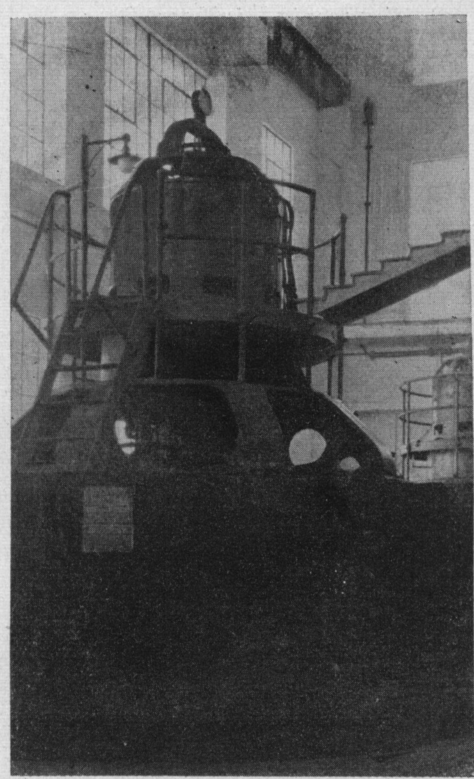
The main control board is of the G. E. bench type, double bus system arranged on bus bar compartments. The 6,600 volt circuit breaker is of the H. 6 oil type made by the General Electric Company, their interrupting capacities being guaranteed to 20,000 ampères at 15,000 volts normal frequency.

Outdoor Installation

This consists of two G.-E. step-up transformers, each single phase, water-cooled, 6,600 k.v.a., 6,600-89,000 volts, 50 cycle, connected up delta-star, the neutral point being grounded through 900 ohms resistance, The double bus arrangement is on a steel frame structure. The oil circuit breakers for 154 k.v. are of the FHKO-36-42 B type made by the G.-E. Company, the interrupting capacities being guaranteed at 2,300 ampères at rated voltage and frequency. The first oxide film lighting arresters for such high voltages to be used in Japan have also been installed.

Transmission Line

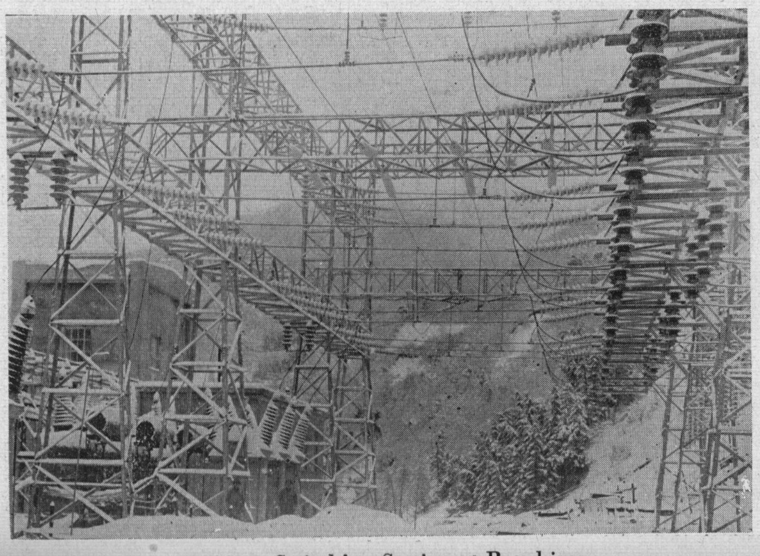
The transmission line extending from Ryushima to Totsuka, near Yokohama, 125 miles in length, cost Y.10,000,000, or about fifty per cent. of the total installation cost. The line not only transmits power from the Ryushima station, but takes 17,000 k.w. from the Momayama generating station of the Daido Electric Power Company, and 34,000 k.w. from the Takasegawa station of the Toshin Electric Company at the Shioziri switching station, distributing 25,000 k.w. of this power to Tokyo at the Hashimoto switching station.



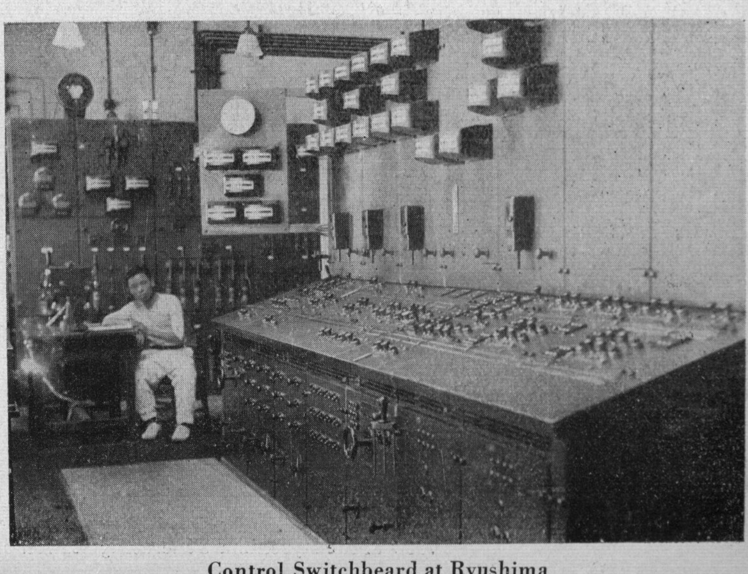
One of the 13,007 k.v.a., G.E. Water Wheel Driven Alternators

The conductors used are steel-reinforced aluminum cables, 409,000 c.m., from the American Aluminum Company, and 400,192 c.m. copper cables of Japanese manufacture. The aluminum cables are used on the first ten-mile section where transmitted power is assumed to be less than in the further sections.

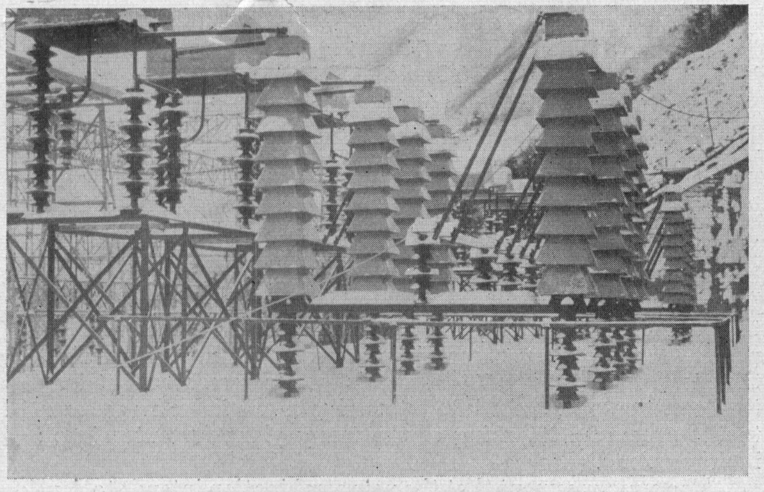
There are 942 galvanized steel towers set on concrete foundation, including 689 standard towers, 168 angle towers, 68 strain towers, 8 transposition towers and 9 special towers carrying three phase single circuit on each side and a ground cable on their tops. Thel ine conductors are arranged vertically, the upper and lower laying conductors on a vertical plane with a horizontal offset of 2-ft. 5-in. for the middle conductor and vertical spacing of 13.5-ft. The line, transposed four complete turns in the total length, is subdivided in five sections by switching stations, where future incoming and outgoing lines will be connected



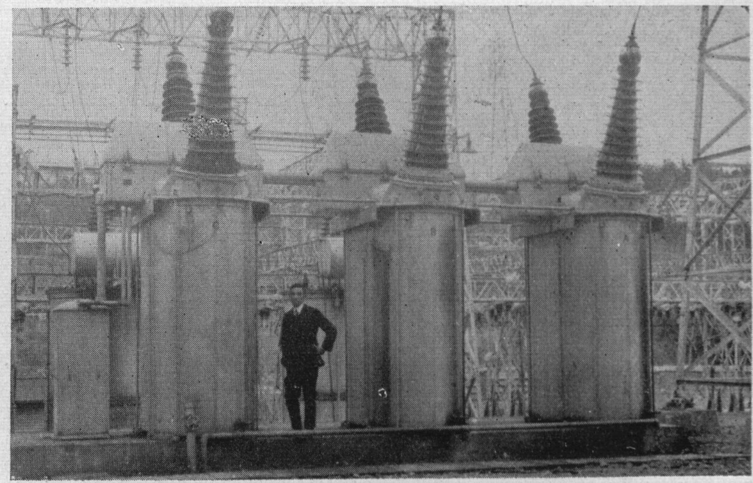
Outdoor Switching Station at Ryushima



Control Switchbeard at Ryushima



Oxide Film Arresters on the Yokohama Line



154,000 Volt Oil Circuit Breakers on the Yokohama Line

Insulators are of the suspension type, ten inches in diameter, part manufactured by the Ohio Brass Co. and part in Japan. There are ten units for standard towers and eleven units for angle and strain towers, etc. Care has been taken that eleven unit stringing is used for high altitudes (4,000-ft. above sea level) along the line. Four circuits of telephone lines are on separate wooden poles, and satisfactory communication is obtained. A relay combination of 6 inverse time limit overload relays IA-101, an auxiliary relay PQ-3, and a duo directional over-current relay IB-Y2, furnished by the General Electric Co., is used at the sending end for line protection. Another relay combination of 3 inverse time limit overload relay, a reverse power relay IK-105, and a low current inverse time limit overload relay IA-103, is used at the receiving end for line protection.

Receiving Station

At the receiving station the transmited power is stepped down from the transmission voltage of 140,000 volts to the feeder voltage of 66,000 volts, and combining the power from the Hakone power stations of Tokyo Dento Kabushiki Kaisha, is distributed to Tokyo, Yokohama and Yokosuka. Two banks of G.-E. step-down transformer, each single phase, water-cooled, 10,000 k.v.a., 11,000 k.v.a., 5,000 k.v.a., 80,900-38,1,000-11,000 volt, 50 cycle are connected up star-star-delta, the tertiary windings of 11,000 volt being provided for synchronous condensers.

Two G.-E. synchronous condensers, each 15,000 k.v.a., 11,000 v., 3 phase, 50 cycle, 600 r.p.m., are installed. Condensers are started by starting compensators. Buses for 140 k.v. and 66 k.v. are arranged on outdoor steel structures. Bus for 11 k.v. is arranged in bus bar compartment.

All switching equipments are manufactured by the General Electric Co. The station will supply power to a sub-station of the Imperial Government Railways in the near future and play an important rôle in the railway electrification.

The Keihin Denryoku has also ordered from the General Electric Company the electrical equipment for what will be the largest automatic hydro-electric power generating station in Japan. The station, to be constructed on the Oshiro river, will consist of a 3,500 k.v.a generator driven by a J. M. Voith Company water wheel, with full automatic control designed to perform automatically and in proper sequence all of the operations of starting, running, and shutting down ordinarily performed by the station attendant in a manually operated station. By simply energizing the transmission line from the controlling power station the wheel is started, the generator is synchronized, and assumes its load.

The equipment includes in addition to the usual protective device of a manually operated station, protection against sustained overloads, hot bearings, low voltage, underspeed, overspeed, and other irregularities usually cared for by the station attendant.

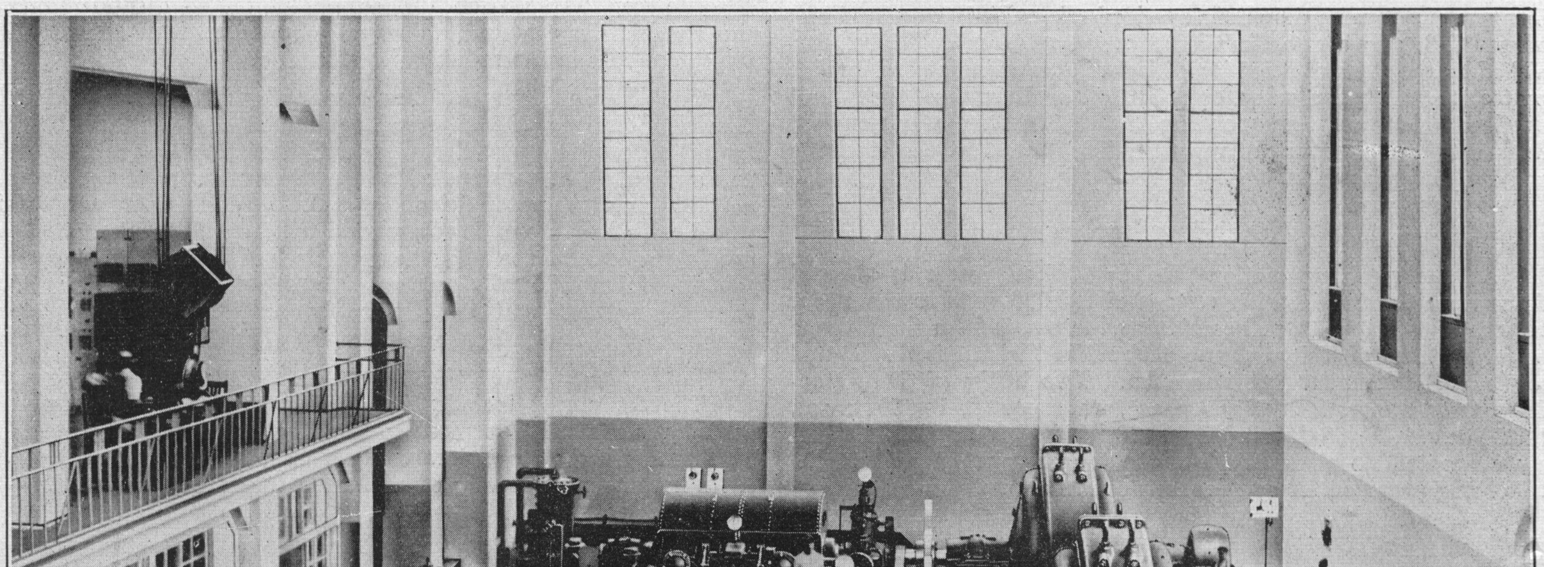
REX CEMENT MIXER USED BY THE TOKYO MUNICIPAL ROAD IMPROVEMENT BUREAU

A 500,000 Kilowatt Development

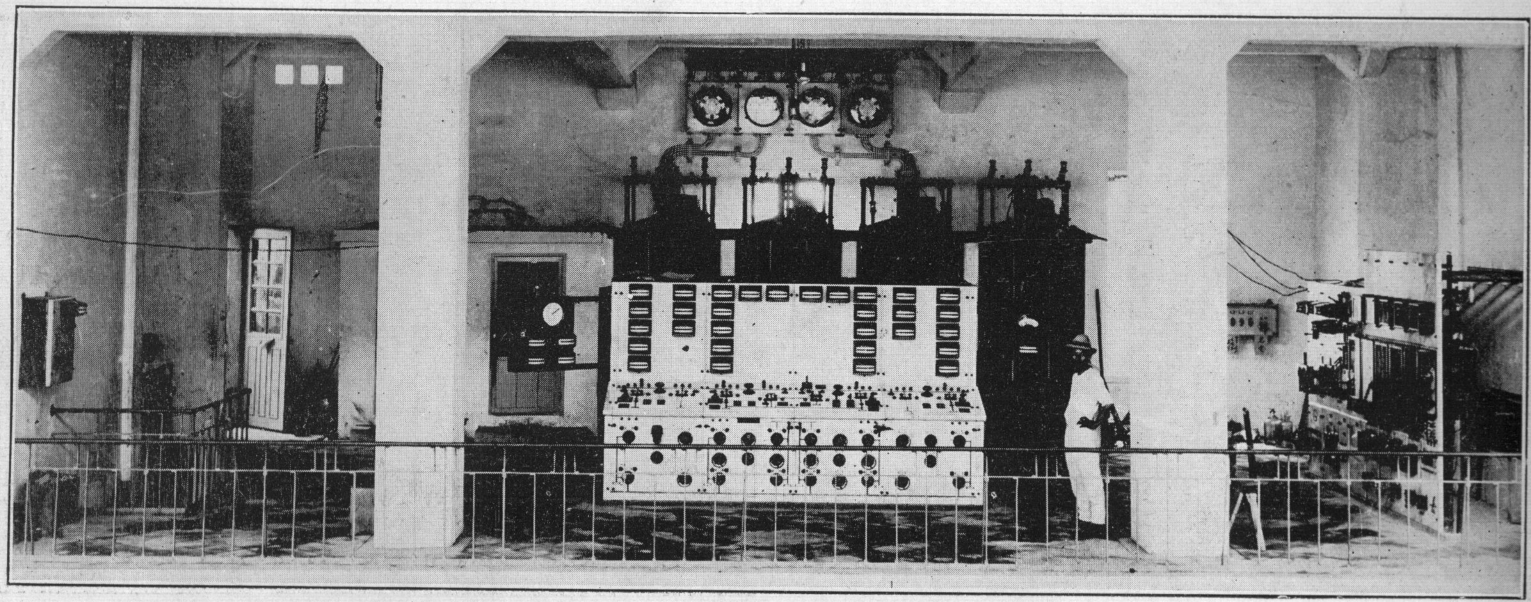
A New Super-Power Enterprise To Supply the Tokyo-Yokohama District: Far-Reaching Plans of the Toho and Tokyo Electric Power Companies

A SUPER-POWER DEVELOPMENT which will take its place amongst the four biggest producers in Japan is the outgrowth of the amalgamation early this year of the Hayakawa and Gunma Electric Power Companies under the name of the Tokyo Electric Power Comany, Ltd. The new enterprise is closely affiliated with the Toho Electric Power Company, the second largest retailer of power in Japan. In fact, the plans of both companies so dovetail into each other that any description of the activities of one would be incomplete without some reference to the other; and when this is told, it will be found that interlocking directorates and power sales agreements have created such a close community of interests between the Toho and the Daido Electric Power Companies that any comprehensive survey of the field must also include the activities of the latter. As the Daido recently established connections with the Tokyo power market by connecting up its Mumayama plant with the Keihin line and feeding into the system of the Tokyo Electric Company, the interests of these four big producers are more or less identical; and, although serving the same market, their relations are being developed along lines of co-operation and not of competition. It augurs well for the future of electric power development in Japan that this commendable spirit of co-operation in the interchange of power exists between those big producers. It not only makes for the steady development of Japan's power resources, but inspires that confidence in the future prosperity of the industry so essential to the successful financing of the many plans for extensions and improvements.

The announcement that the new combination intends to develop power resources in the next few years that will supply 500,000 k.w. to the Tokyo district, followed by the placing of orders for two 35,000-k.w. steam generators to be installed in its Kawasaki (Tokyo) station, at once centered the attention of the business world on its activities. The fact that it is so closely allied with the Toho, and that the experts of this company will direct its affairs, is accepted as a guarantee that it will carry through its program. Both the Daido and Toho companies are controlled by the same interests, Mr. M.



The Kuretsubo Power Plant of the Tokyo Electric Power Company; Equipped with Four 8,000 k.v.a. 11,000 volt, 50 cyles Generators, manufactured by the Shibaura Engineering Works, driven by four 10,000 h.p. Pelton Water Wheels manufactured by Boving & Company.

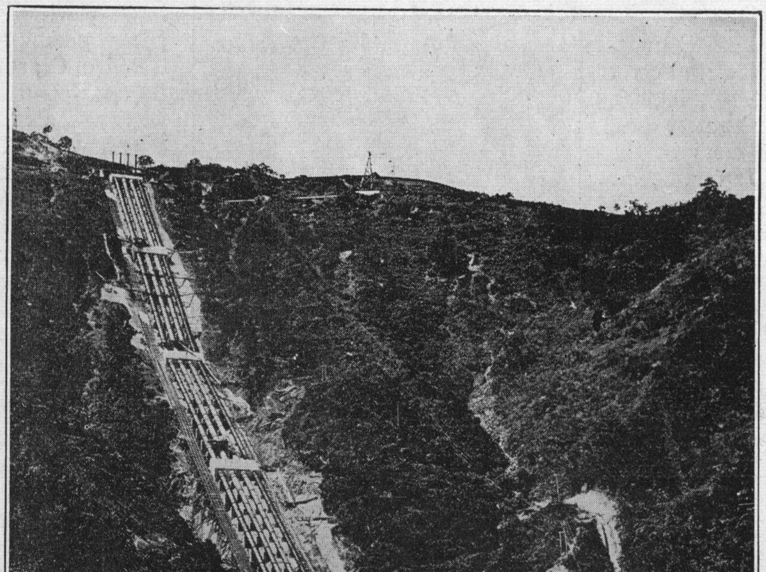


Switch Board of the Kuretsubo Power Plant of the Tokyo Electric Power Company; Made by the Shibaura Engineering Works.

Fukuzawa, president of the Daido Company, being also honorary president of the Toho, while the active head of the latter organization is its vice-president and general manager, Mr. Y. Matsunaga, whose remarkable success in the direction of the Kyushu Electric Power and Traction Company places him amongst the foremost of Japanese public utility operators. Both of these are names to conjure with in Japan, a further assurance that co-operation rather than keen and ruinous competition will smooth the way of the new company in carrying forward its program.

The territory served by the Tokyo Electric Power Company between Tokyo and Yokohama, covering nearly 50 square miles, is an ideal one for development. This section, owing to its excellent transportation facilities with a deep-water outlet at Tsurumi and Yokohama, is destined to become the industrial center of eastern Japan. Many large and important industries have already erected manufacturing plants along the seashore, while the hill section overlooking the bay and Yokohama harbor is rapidly being transformed into beautiful residential districts. Omori, Tsurumi, Kawasaki and other points are experiencing a boom since the earthquake, many families seeking permanent homes there in preference to relocating in the near-by cities. The Tokyo Electric Power Company not only supplies these districts with light and power, but holds a franchise which permits it to sell power in Yokohama and Tokyo as well as in the important suburbs of Shinagawa, Meguro, Yodobashi and Nakano.

A feature of the development in this district is the program of the Denyen Real Estate Company to build some 5,000 new homes on the line of the Meguro-Kamata Inter-urban Electric Railway, every house to be fitted throughout with electrical apparatus for lighting, cooking, heating, etc. This is the outcome of the propaganda for the electrification of the home, started last year by a group interested in reducing fire risks and bringing greater comfort into the home. In this " electric home " district will also be located two of the best institutions of learning in Japan, the Higher Commercial and the Higher Technical Colleges. These colleges will also be electrified in every respect with modern electrical equipments. Home electrification has become a slogan, and the proposed 5,000 electric homes will be followed by many others in the company's territory.

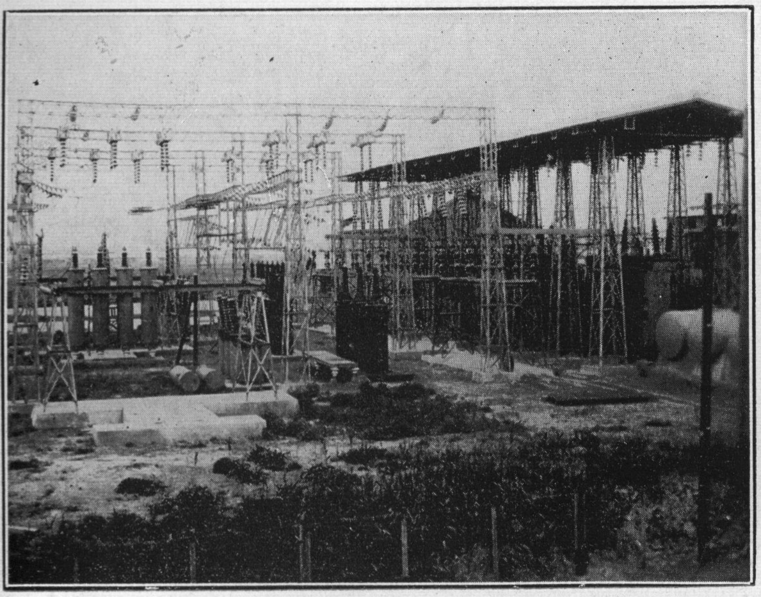


The Kuretsubo Power Plant (20,000 k.w.) of the Tokyo Electric Power Company.

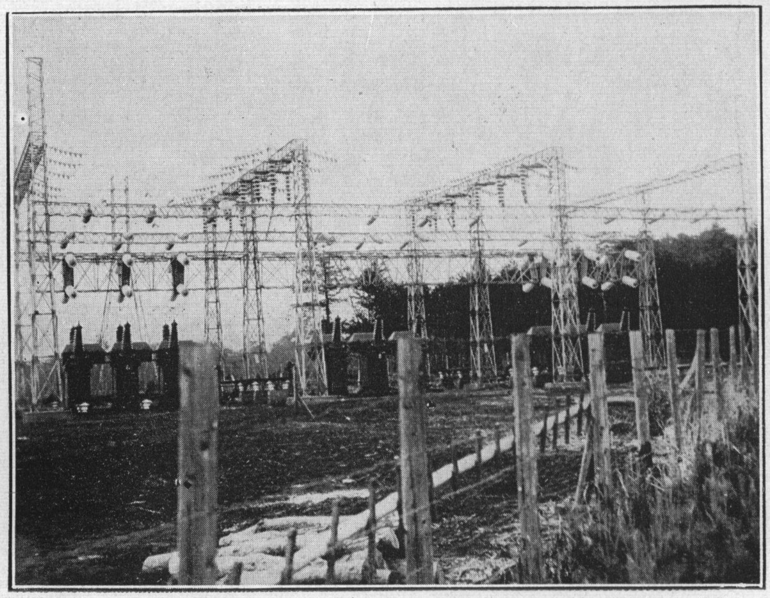
The company also serves Shizuoka, one of the richest prefectures in Japan (situated midway between Nagoya and Tokyo), noted for its tea, silk, cotton goods, sea products, vegeable oils, etc. It has the mildest climate in the main island, and consequently raises abundant farm products, which are shipped to Tokyo and Nagoya. The company also serves a territory in Gunma prefecture.

The growth of the Tokyo Electric Power Company, Limited, formed by the amalgamation of several companies in the last several years, is typical of the general course of electrical development in Japan. One of its principal component enterprises, the Hayakawa Electric Power Company, organized on June 28, 1918, with a capital of Y.8,000,000, took over by consolidation in 1920 the business and properties of the Anglo-Japanese Hydro-Electric Company, increasing its capital to Y.15,000,000.

On March 12, 1924, the Toho Electric Power Company, Limited, organized the Hayakawa Industrial Company with a capital of Y.15,000,000, and subscribed to all the stock, paying in a quarter on the date of its foundation. The Toho also acquired some shares of the old Hayakawa Electric Power Company. On March 31, 1924, the Hayakawa Industrial and Electric Power Companies were



Kawaski Sub-Station No. 1



The Kichijoji Switching Station

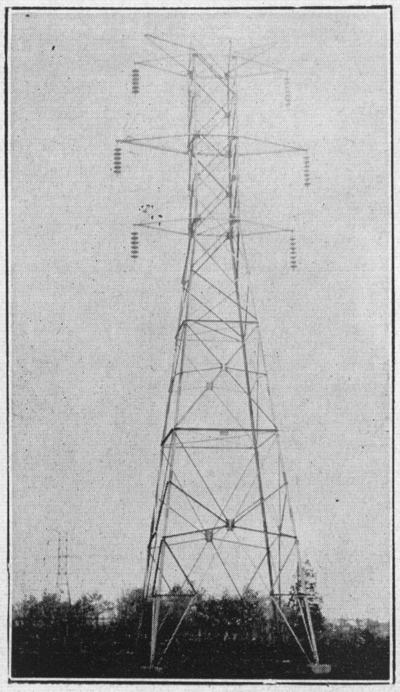
amalgamated and the Toho Electric Power Company assumed control of the new combination, whose capital was increased to Y.30,000,000.

While the Hayakawa Electric Power Company was extending its activities in the Tokyo district and in Gunma prefecture, the Guma Electric Power Company, organized in 1917, developed water power in Gunma prefecture and in 1922 started the transmission of power to Kawasaki City, located midway between Tokyo and Yokohama.

Early in 1925 these two concerns amalgamated under the name of the Tokyo Electric Power Company, Limited, with a capital of Y.42,250,000, serving over 144,000 lighting customers and approximately 11,500 power customers in the most densely populated sections of Japan. New customers are being added as the company's power generating facilities increase. The company also operates an electric railway in Gunma prefecture.

Power Plants

The company's power plants have a total generating capacity of 128,000 k.w. This includes the new Tokyo steam plant, under construction, with an initial installation of two 35,000 k.w. steam turbo generators, and an ultimate capacity of 140,000 k.w.



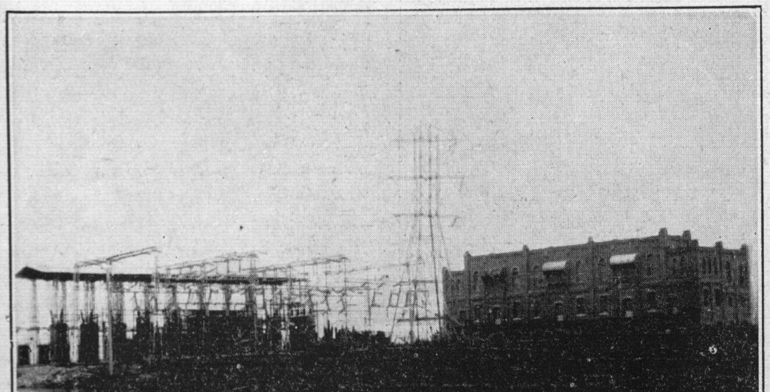
Steel Towers in 110,000 volt Transmission Line

Tokyo Steam Power Plant

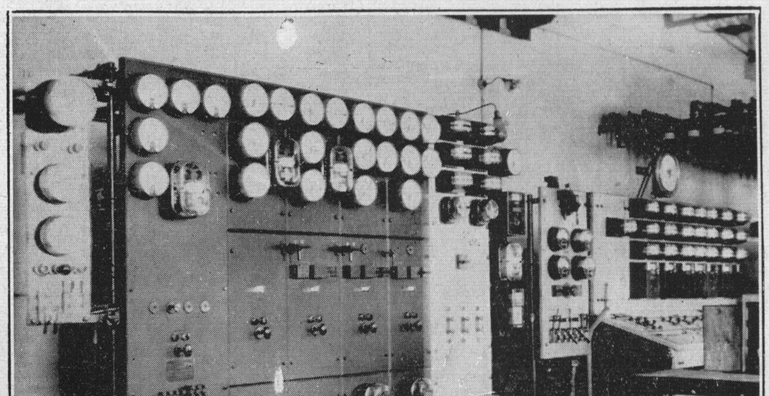
In the Tokyo district there is always a power shortage during the dry season, which extends from December to March, at a time when the demand reaches its maximum.

In order to meet the rapidly growing demand in its territory, the Tokyo Electric Power Company plans to develop water powers in the Tashiro, Oi, and Tenryu rivers. The Tenryu will be developed by the Toho Electric Power Company and also build the most efficient super-power steam plant in Tsurumi. The steam plant costs less per unit and can be built in a shorter period.

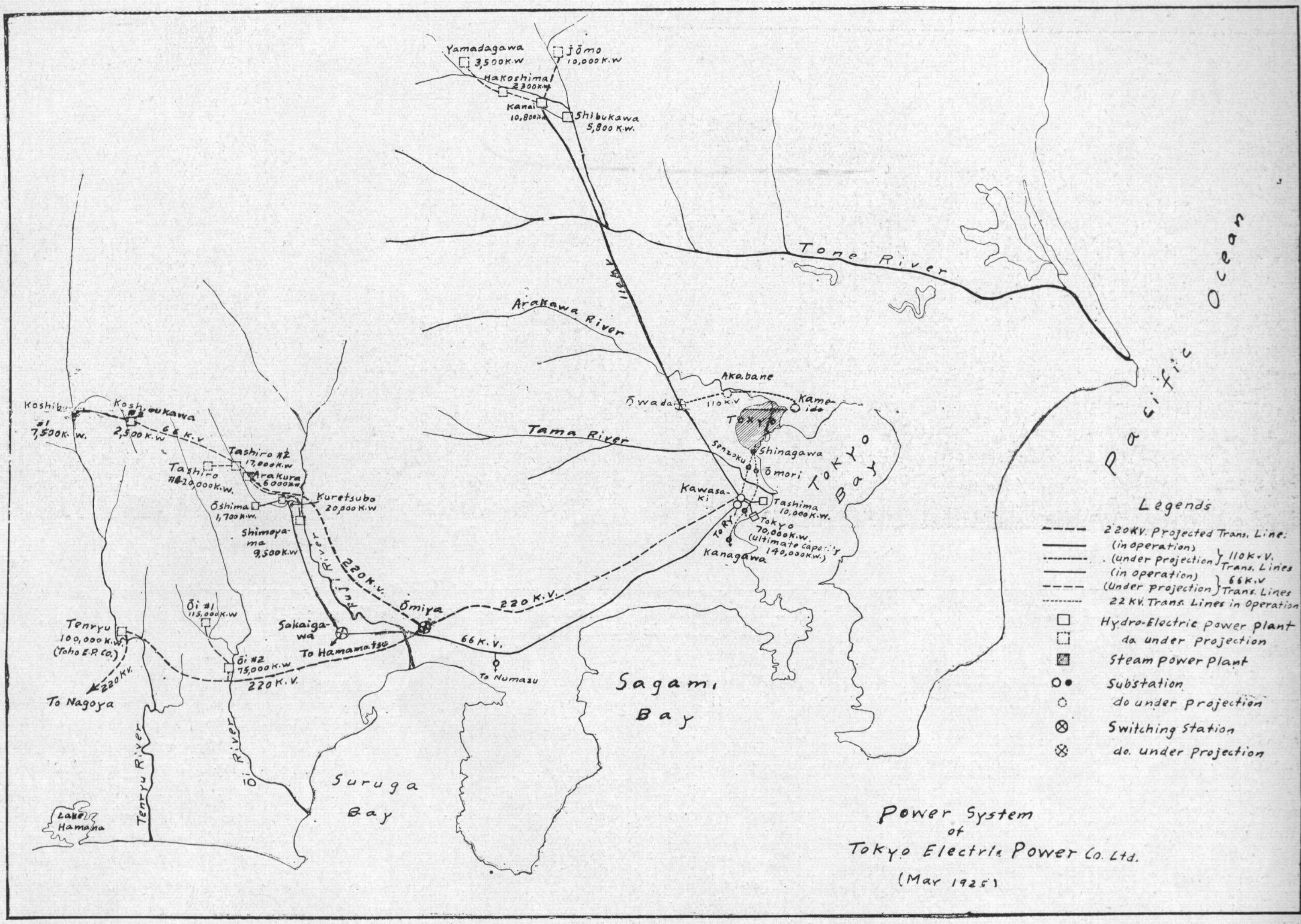
Sufficient water for condensing, good transportation and coal handling facilities are two essentials for a modern steam power plant, and in these respects the new plant, covering a site of 30,000 *tsubo*, is ideally located on the reclaimed land at Tsurumi, with abundant sea water for condensers, and where coal can be unloaded from 10,000-ton steamers direct to the storage yard. The plant will require at least 1,000 tons of coal per day even during the next four or five years, when its load is comparatively small.



General View of Kawasaki Sub-Station No. 1.



Switch Board of Kawasaki Sub-Station No. 1.



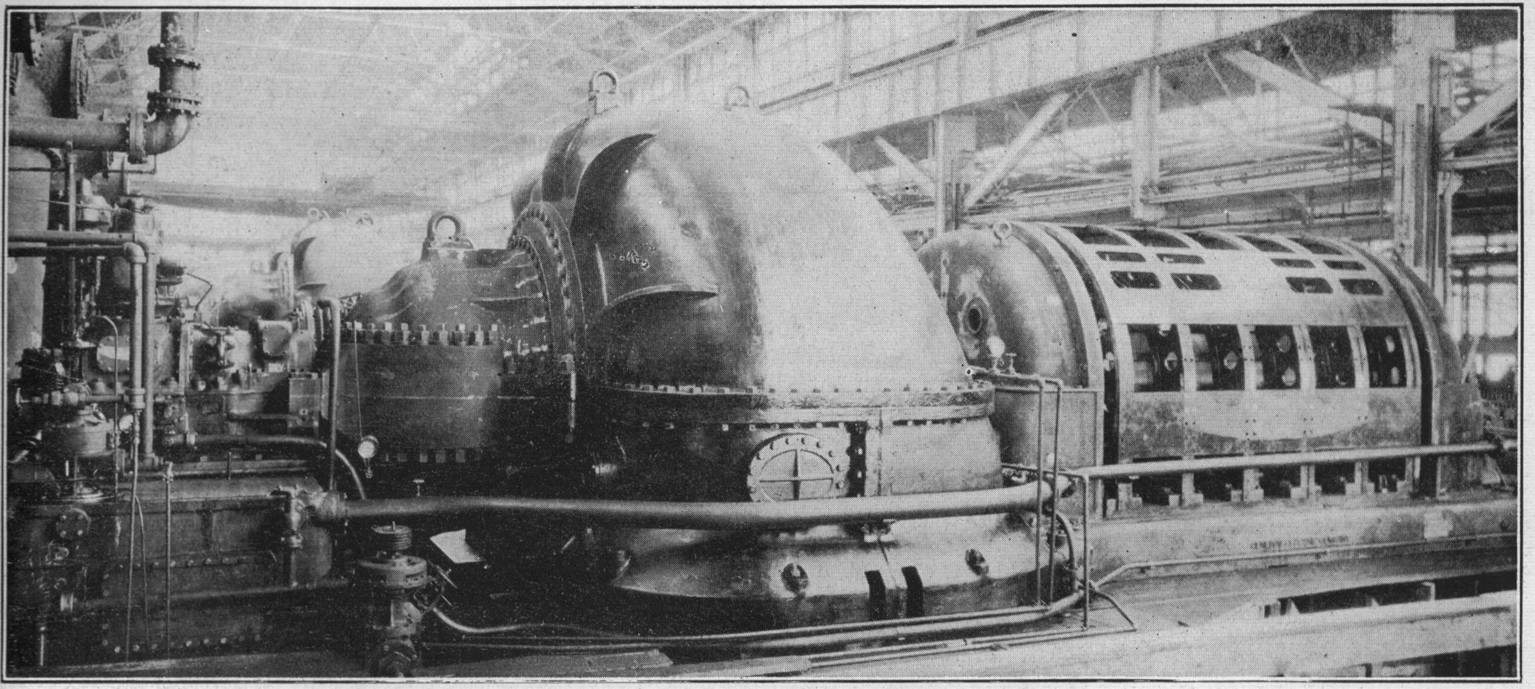
Power System of the Tokyo Electric Power Company, (May, 1925)

TURBO-GENERATORS.—The two main steam turbo-generators for this plant are of the Curtis Impulse type manufactured by the General Electric Company of America. The turbine proper contains twenty impulse stages and embodies all up-to-date improvements, including steel shell, monel metal buckets, and automatic provisions for emergency stopping.

An interesting feature is the provision for the extraction of steam from two of the intermediate stages, the extracted steam to be used for heating the feed water before it is pumped into the boilers. The system of feed water heating adopted is known as the Allen contraflow, and includes deaereators, evaporators, and closed heaters, all supplied by extracted steam. With this combination of heating system and twenty-stage turbine, remarkable steam economies will be effected, by which a kilowatt hour will be generated with an expenditure of only 9.6 pounds of steam. The pressure of 375 pounds and temperature of 750 deg. F. at which steam will be supplied to these units is the highest yet adopted in Japan and follows the best American practice.

45,000 sq. ft. (35,000 k.w,) "Contraflo" Condensers for the Steam Turbo-Generators at the Kawasaki Palnt of the Tokyo Electric Power Co., Ltd. Two of these Condensers have been furnished by W. H. Allen, Sons, & Company, Ltd.

The alternating current generators connected to these turbines will be the largest ever shipped to Japan. They are rated 35,000 k.w., 43,750 k.v.a., 50 cycle, 3 phase, 11,000 volts, 1,500 r.p.m. A novel feature will be the installation of GE closed type air coolers, by means of which the cooling air for these generators will be circulated in an enclosed system. Heat will be removed by means of cold water circulated through the tubes of these coolers. This system is now being adopted by practically all of the large power stations in America. The accompanying photograph gives a good



Two General Electric 35,000 k.w., 1,500 r.p.m., 20 Stage Steam Turbine-Generator Set for the Kawasaki Steam Plant of the Tokyo Electric Power Co., Ltd.

idea of the appearance of these machines, and the internal construction is shown in the cross section illustrated at the end of this article.

Power for operating station auxiliaries will normally be supplied through a transformer bank connected to the station bus bars, but for starting up and for emergency operation there is provided a 2,500 k.w. 3,300 volt Curtis type house turbo-generator made by the General Electric Company. This unit will run idle during normal operation of the plant, receiving only sufficient steam to overcome machine friction, and will be so regulated that if failure of the auxiliary transformer bank occurs the turbine will immediately pick up the station service load and avoid shut-down of the plant.

As the load increases, an additional two 35,000 k.w. units will be added, making the total capacity of the plant 140,000 k.w.

Kuretsubo Plant

The Kuretsubo hydro-electric power plant, completed in 1923, is situated on the Hayakawa, a tributary of the Fuji river. It has a generating capacity of 20,000 k.w. and 750-ft. of effective head, and utilizes 430 cubic ft. of water per second. A part of the power generated by this plant is transmitted to Kawasaki.

Four 8,000 k.v.a. horizontal generators manufactured by the Shibaura Engineering Works are connected to water wheels, each rated for 10,000 h.p., manufactured by Boving & Co. There are four Shibaura 3 phase main transformers, each rated for 8,000 k.v.a., raising voltage from 11,000 to 66,000 volts.

Kanai Power Plant

The Kanai power plant is situated on the Agatsuma river, some 83 miles north-west of Kawasaki. Its effective head is 140 ft. and the available quantity of water is 1,200 cubic ft. per second. Its total generating capacity is 10,800 k.w., having three 3,600 k.w. 3 phase, 50 cycle, 6,000 volt Shibaura generators.

The plant contains nine 3,500 k.v.a. single phase transformers, manufactured by the Westinghouse Electric Manufacturing Co., primary sides of which are wound for 6,600 volts and secondary sides 66,330 to 60,730 volts. Three transformers are connected in star to give 110 k.v. for the transmission line. There are also four 1,250 k.v.a. transformers for local service.

Shibukawa Plant

The Shibukawa power plant is located at the down stream of the Kanai plant and has an effective head of 69-ft. Its generating capacity is 6,000 k.w., having two 4,250 k.v.a. Westinghouse generators connected to Escher Wyss water wheels.

Power Plants

Hydro-Electric Plants

Name of Plant	Generator No. of Unit.	Generator Capacity of each Unit K.V.A.	Authorized Capacity. K.W.
1. Kuretsubo, completed June, 1923 ...	4	8,000	20,000
2. Kanai, completed October, 1922... ...	3	4,250	10,800
3. Shibukawa, completed March, 1925 ...	2	4,250	5,800
4. Tomoegawa, completed January, 1916 ...	1	1,750	1,500
5. Koyama, completed July, 1911	2	825	1,400
6. Shirase, completed January, 1920 ...	1	1,500	1,119
7. Oshima, completed November, 1920, and is now under reconstruction... ...	—	—	1,700
8. 5 Small power plants	—	—	407
9. Arakura, under construction	—	—	6,000
Total			48,726

Steam Power Plants

Name of Plant	(around Tokyo) Generators K.W.	Capacity K.W.
Tashima to be completed in 1925...	2—5,000	10,000
Tokyo, to be completed in 1926	2—35,000	70,000 (Ultimate capacity 140,000 k.w. 4-35,000 units)
Total		80,000 (ultimate 150,000 k.w.)

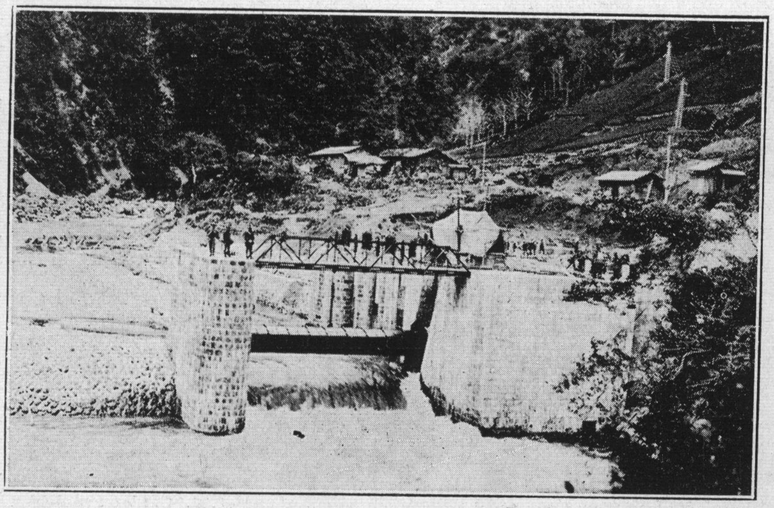
Transmission Lines

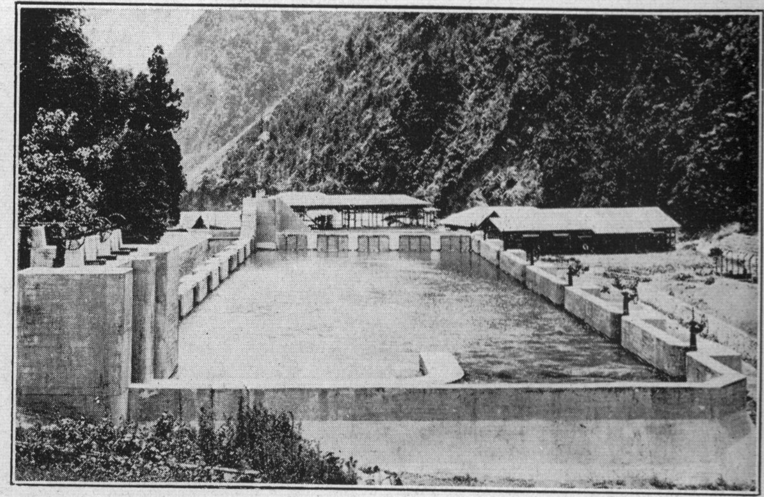
The company has approximately 440 miles of transmission lines, most of the double circuit type of construction. Steel towers are exclusively used for 110 k.v. line, while for 66,000 volts, concrete, steel, and wooden poles are used. Gantry towers are used where lines cross rivers, railroads, etc.

The following table shows the important transmission lines:—

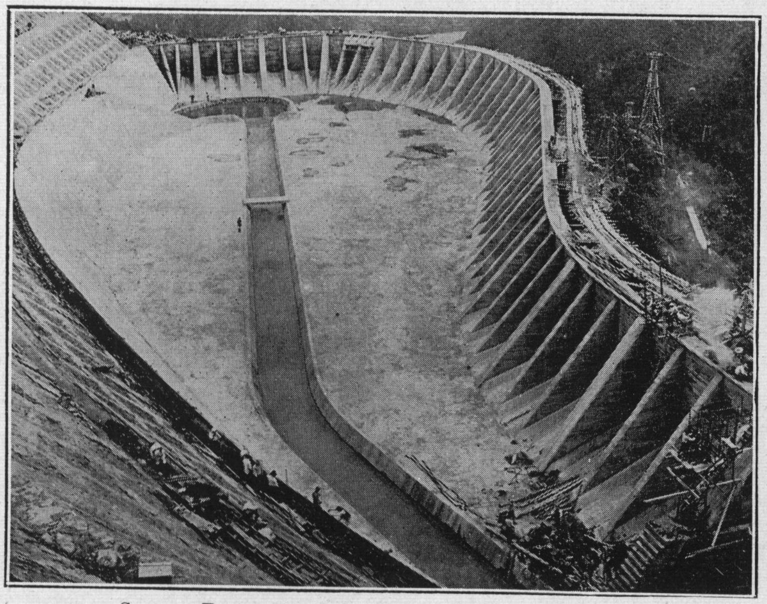
Transmission Lines (constructed)

Voltage	Construction		Transmission Distance—Miles
110,000 volts ...	2 circuits steel towers		83.80
66,000 volts ...	Mainly 2 circuits concrete poles, steel poles and towers		151.28
35,000 volts ...	Mainly 2 circuits all wooden poles except where it crosses rivers		140.77
22,000 volts ...	Underground lines	5.20	
	Overhead lines	19.56	
Total ...			24.76
11,000 volts and under			40.57
Total length of Transmission Lines			441.18

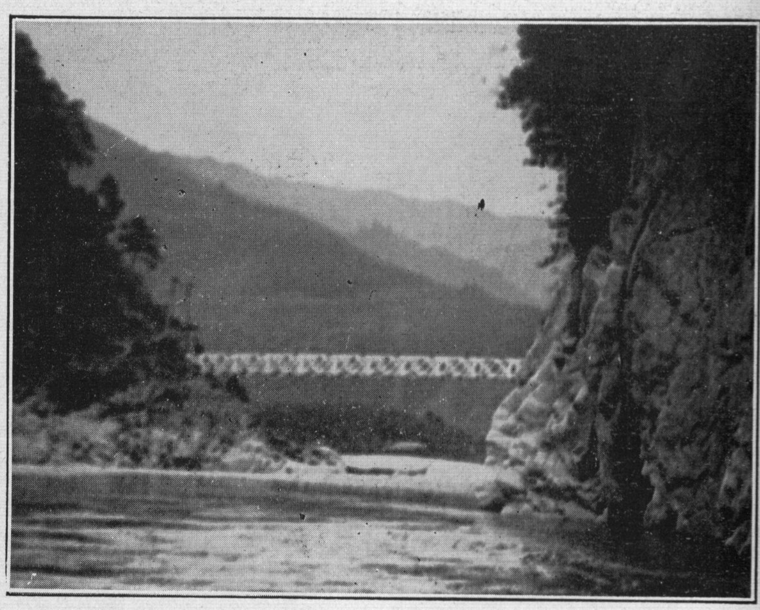




Intake and Sand Basin of the Kuretsubo Power Plant



Storage Reservoir of the Kuretsubo Power Plants.



The Toho Electric Power Company's Proposed 300-foot Dam Site on the Tenryu River to develop 100,000 k.w. of Power for Transmission to Tokyo

SUB-STATIONS

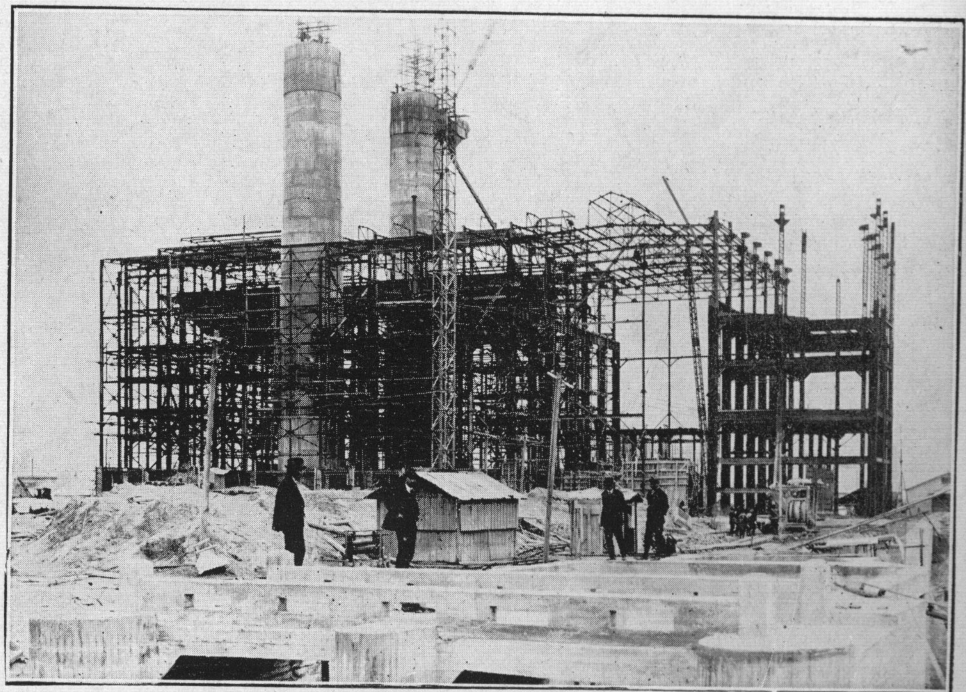
At present the company has 25 sub-stations which are interconnected and provided with protective and safety devices to insure safety to apparatus and continuity of operation.

The following table gives the operating capacity and spare capacity of the main transformers of the stations:

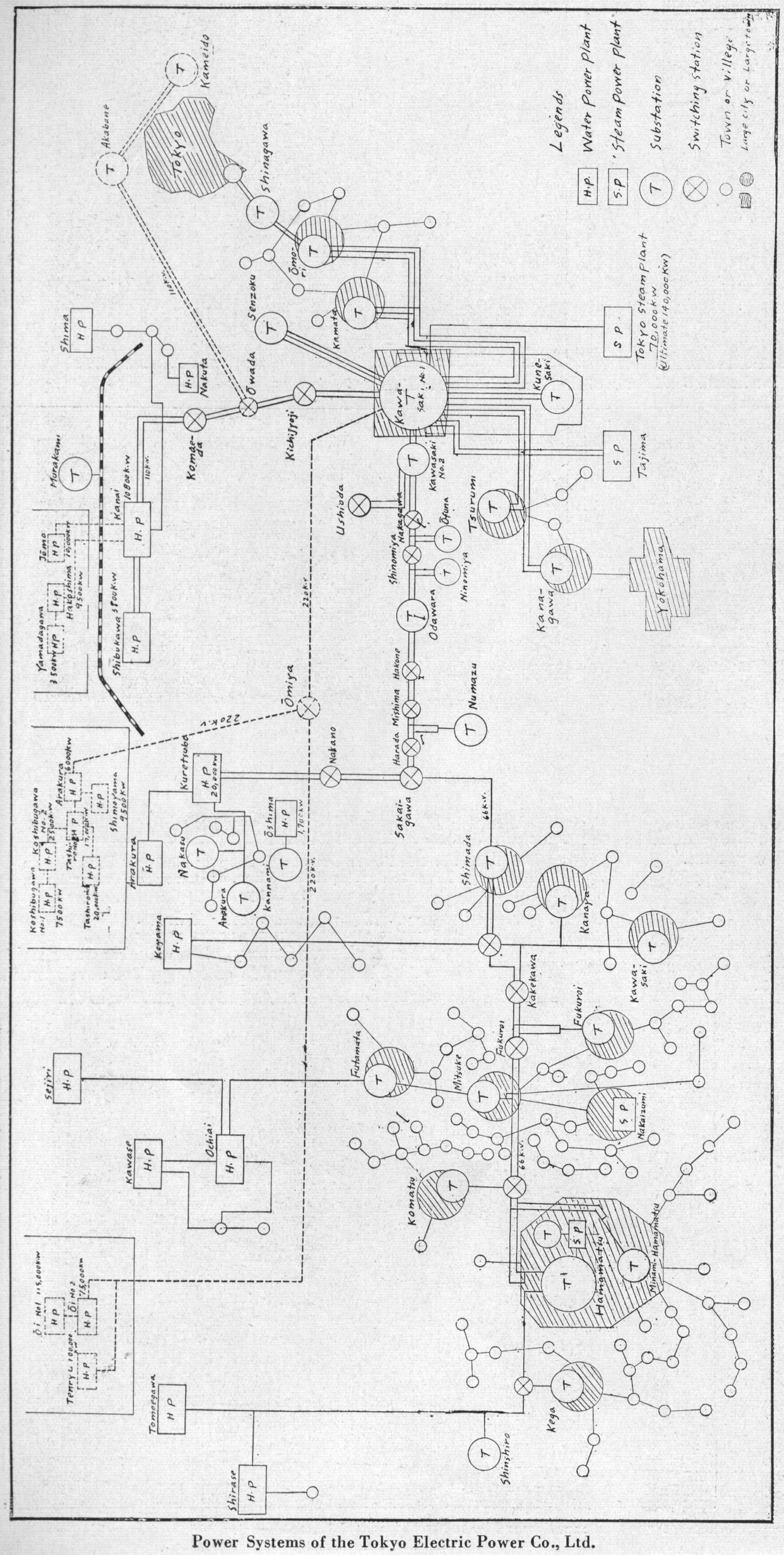
Sub-stations	Operating Transformer Capacity. K.V.A.	Spare Transformer Capacity. K.V.A.	Total Installed Transformer Capacity. K.V.A.
1. Hamamatsu	4,960	—	4,960
2. Minami-Hamamtsu	3,000	1,000	4,000
3. Carbide Factory	846	—	846
4. Kega ...	1,380	230	1,610
5. Komatsu ...	3,000	—	3,000
6. Fukuroi ...	1,500	—	1,500
7. Toen ...	870	—	870
8. Kanaya ...	900	—	900
9. Shinshiro ...	450	150	600
10. Mitsuke ...	1,860	—	1,860
11. Shimada ...	9,000	3,000	12,000
12. Futamata ...	360	—	360
13. Numazu ...	1,390	—	1,390
14. Kawasaki No. 1	39,000	16,500	55,500
15. Kawasaki No. 2	15,000	7,500	22,500
16. Kunezaki ...	3,000	1,000	4,000
17. Kamata ...	3,000	1,000	4,000
18. Omori ...	3,000	500	3,500
19. Tsurumi ...	4,500	1,500	6,000
20. Kanagawa	3,000	1,000	4,000
21. Senzoku ...	3,000	1,000	4,000
22. Shinagawa	3,000	1,000	4,000
23. Arakura ...	450	150	600
24. Nakazu ...	120	—	120
25. Odawara ...	7,500	2,500	10,000
Total ...	1140,86	38,030	152,116

Future Power Development

The Tokyo Electric Power Company has valuable water rights in the Tashiro and Oi rivers capable of economical development.



Nagoya Stoam Power Plant. 70,000 k.w. (ultimate capacity, 105,000 k.w.); Under Construction for the Toho Electric Power Co., Ltd.



Power Systems of the Tokyo Electric Power Co., Ltd.

In the next seven to ten years the Company intends to obtain approximately 100,000 k.w. from the Tashiro river and about 200,000 k.w. from the Oi and its tributaries. The interesting feature of the Tashiro river development is the available high heads. According to the present plan, the effective head of Tashirogawa No. 1 plant is 1,800-ft., while that of No. 2 is 1,200-ft. These two plants may be combined into one 37,000 k.w. plant, having an effective head of 3,000-ft.

The Toho Electric Power Company will start work on the construction of a dam approximately 300-ft. high at Sakuma on the Tenryu river. The generating capacity of this plant will be over 100,000 k.w.

Thus in the next seven to ten years approximately 400,000 k.w. of water power will be developed by the Toho and Tokyo Electric Power Companies. The company also has a plan to purchase approximately 100,000 k.w. from Toho's sister companies, giving Tokyo and Toho approximately 500,000 k.w. available for the raipidly increasing demands of their customers in Tokyo district.

In order to transmit 500,000 k.w. of power to the Tokyo district, Toho and Tokyo Electric Power will build two double circuit transmission lines through the Tokaido, the center of Japan. These transmission lines will be at first 110,000 volts, and the main lines raised to 220,000 volts as the amount of power to be transmitted increases.

The following table gives some of the more important water power plants of the Tokyo Electric Power Company under projection:

HYDRO-ELECTRIC PLANTS UNDER PROJECTION

Name of Plant	Year to be Completed	Capacity. K.W.
Tashirogawa No. 2	1927	17,000
Yamadagawa ...	1927	3,500
Tashirogawa No. 2	1928	20,000
Hakoshima ...	1928	10,000
Shimoyama ...		9,500
Oigawa No. 1 ...		115,000
Oigawa No. 2 ...		75,000
Koshibukawa No. 1		7,500
Koshibukawa No. 2		2,500
Total ...		260,000

MARKET FOR 500,000 K.W. OF HYDRO-ELECTRIC POWER.

Markets for half million k.w. of power to be obtained from the Tashiro, Oi, Tenryu, and other rivers in the central part of Japan will be as follows:—

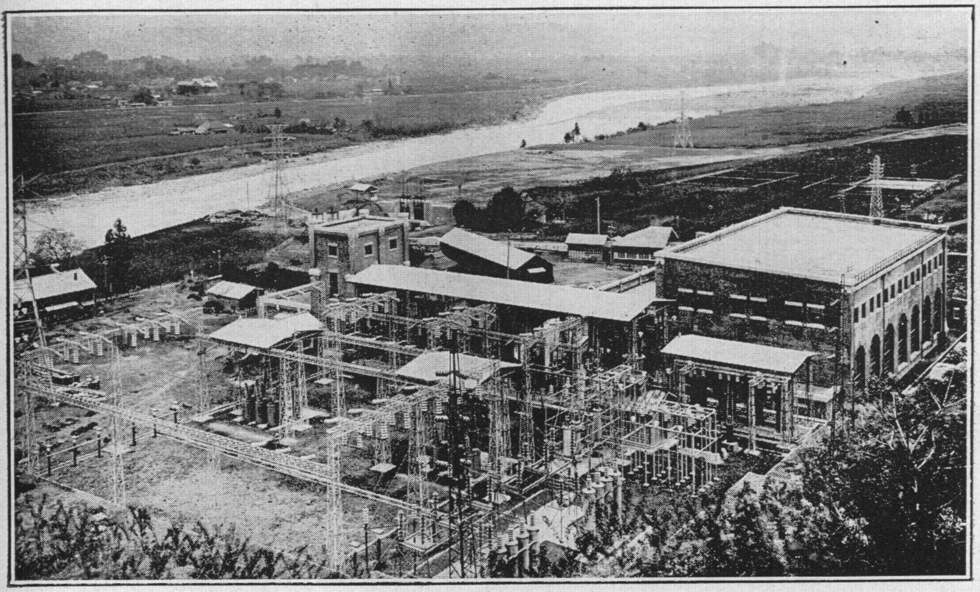
(1) 100,000 k.w. Tokaido Railway. The electrification of this line is an urgent necessity to relieve congestion.

(2) 100,000 k.w. For the electrification of military arsenals and naval dockyards, etc.

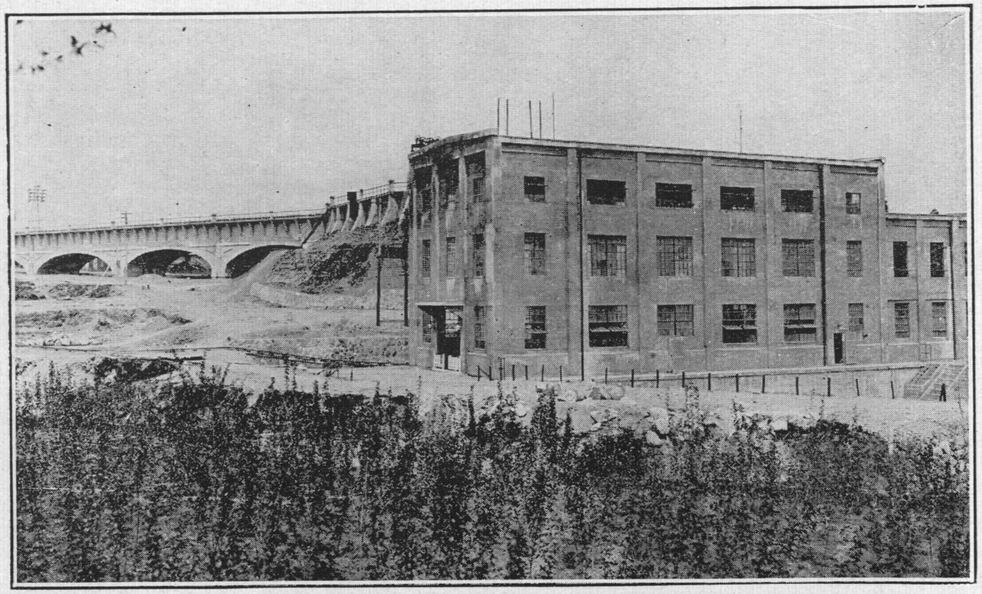
(3) 300,000 k.w. For the demands of customers in Tokyo district and along the Tokaido railways.

The company's territory in Tokyo district, as well as along the Tokaido railway, is more densely populated than anywhere else in Japan, and consequently the demand for electrical energy in the territory lying between Nagoya and Tokyo is limited only by the ability of power companies to make additional generating and

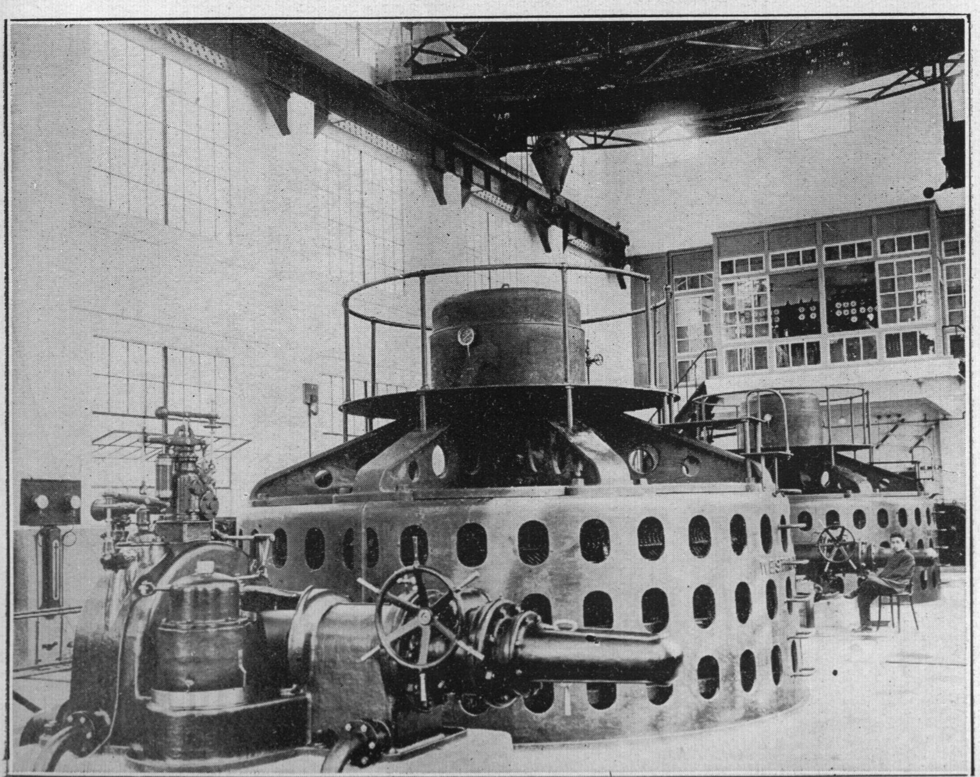
GENERATING PLANTS OF THE TOKYO ELECTRIC POWER COMPANY, LTD.



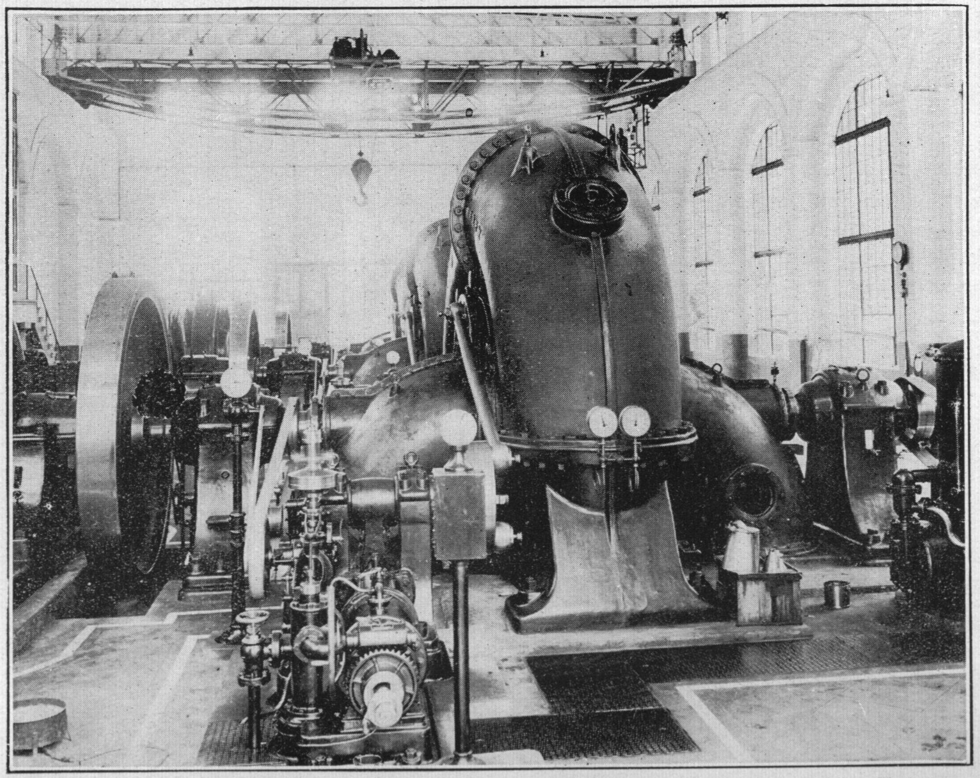
General View of the Kanai Power Plant, 10,800 k.w.



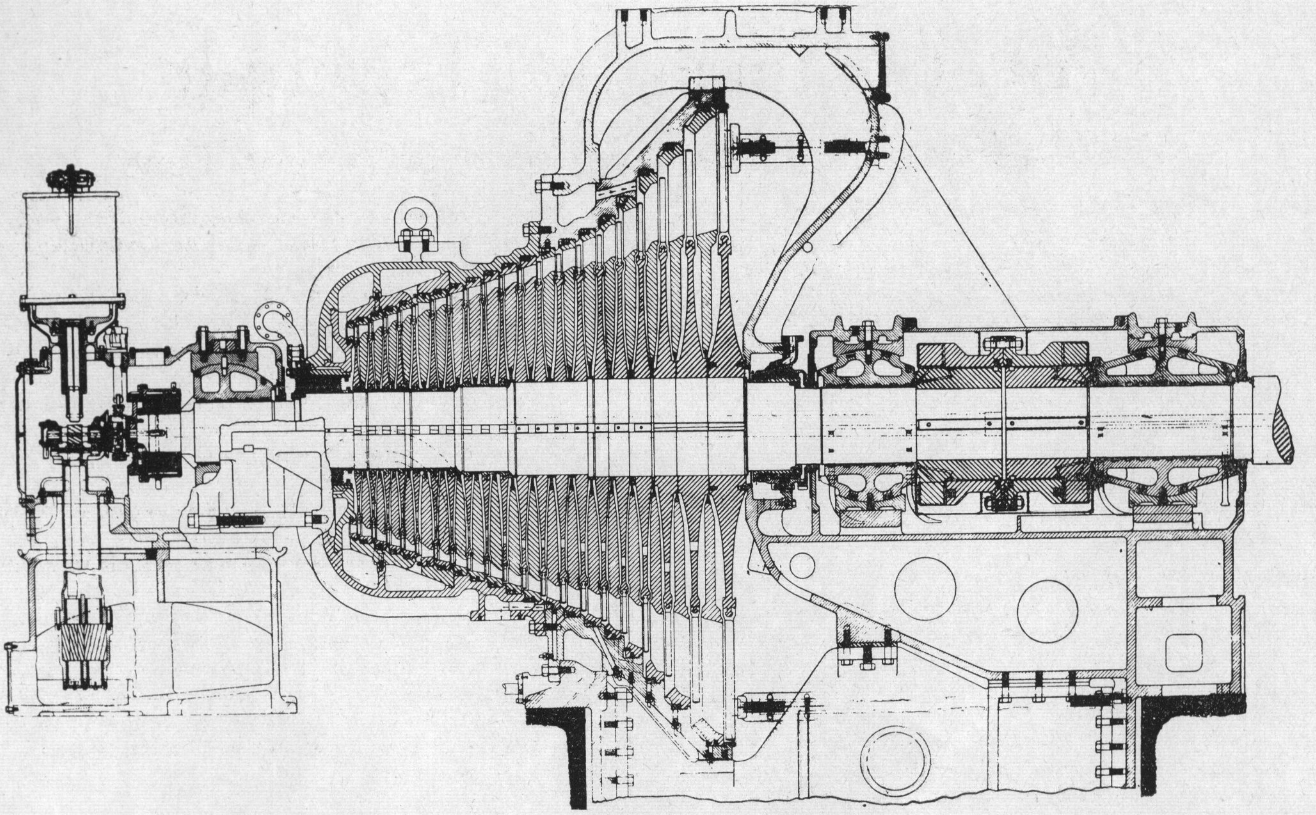
Shibukawa Power Plant; 6,000 k.w.



Generating Room of Shibukawa Power Plant; Two 4,250 k.v.a. Westinghouse Generators driven by Escher, Wyss Water Wheels.



Generating Room of Kanai Power Plant; Three 3,600 k.w., 3-phase, 50 cycle, 6.600v. Shibaura Generators driven by Dengyosha Water Wheels.



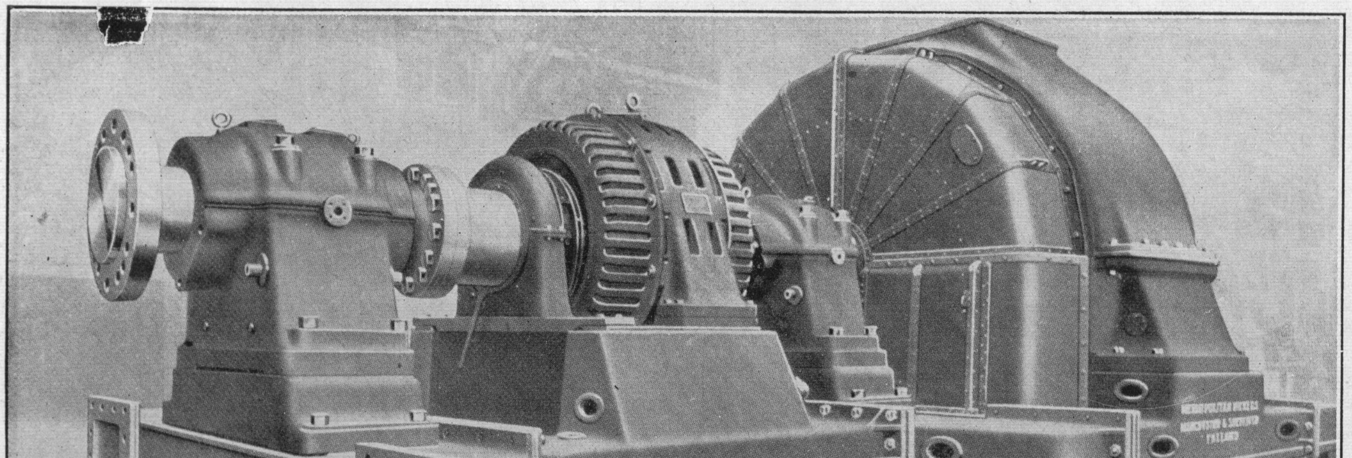
Assembly of 35,000 K.W.-1,500 r.p.m.-20 Stage Horizontal General Electric Curtis Steam Turbine for the Tokyo Electric Power Company's Kawaskai Steam Plant.

distributing facilities. Proposed 220 k.v. transmission lines connecting various water power plants of Toho and Tokyo with Tokyo steam power plant (140,000 k.w.) and Nagoya steam power plant (105,000 k.w.) of Toho Electric Power Company, customers will be assured of good service all the year around, disregarding weather conditions.

The following table gives some of the present power customers of the Tokyo Electric Power Company :

Some of Power Customers

Imperial Government Railway (for electrification of Tokaido Line)	10,000 k.w.
Tokyo Bay Reclamation Co.	3,000 ,,
Tokyo Municipal Railway	5,000 ,, (10,000 k.w. in near future)
Keihin Electric Railway	2,500 k.w.
Fuji Gas Spinning Co.	2,000 ,,
Fuji Hydro-Electric Company	800 ,,
Tokyo Electric Light Company	2,000 ,,
Total Light and Power Demand in Hamamatsu District	10,000 ,,
Total Light and Power Demand in Suburb of Tokyo...	15,000 ,,



Metropolitan Vickers Frequency Changer with an Output of 16,000 k.v.a. for Momoyama Power Station, Japan. This machine weighs 208 tons and its overall length is 50 ft. 6 in.